

## **Indoor Air Quality and Vapor Intrusion Assessment: Report of Second Sampling Round Results**

**Residence, Parcel 26/ 05/ 05 – North  
Wells G&H Superfund Site  
Woburn, Massachusetts**

August 2011

*Submitted to:*

**United States Environmental Protection Agency Region 1**  
5 Post Office Square, Suite 100  
Boston, Massachusetts 02109-3912

*Prepared for:*

**UniFirst Corporation**  
68 Jonspin Road  
Wilmington, Massachusetts 01887



*Nadine Weinberg*

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Nadine Weinberg  
Principal Scientist/Project Manager

*Brian Magee*

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Brian Magee, PhD  
Vice President and Principal Toxicologist  
Human Health Risk Assessment Technical Leader

**Indoor Air Quality and Vapor  
Intrusion Assessment:  
Report of Second Sampling  
Round Results**

Residence, Parcel 26/ 05/ 05 – North  
Wells G&H Superfund Site  
Woburn, Massachusetts

Prepared by:  
ARCADIS U.S., Inc.  
482 Congress St  
Suite 501  
Portland  
Maine 04101  
Tel 207.828.0046  
Fax 207.828.0062

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## **1. Introduction**

On behalf of UniFirst Corporation (UniFirst), ARCADIS has prepared this Indoor Air Quality and Vapor Intrusion Assessment: Report of Second Sampling Round Results for sampling conducted on June 16-17, 2011 at the northern half of the residential duplex in Woburn, Massachusetts, identified in the tax assessors' records as Woburn Parcel Number 26/ 05/ 05 (the Residence). ARCADIS conducted sub-slab soil vapor, indoor ambient air, and outdoor ambient air sampling at the Residence during June 2011. All work was completed in accordance with the *Vapor Intrusion Assessment Work Plan (Work Plan)* approved by the United States Environmental Protection Agency (USEPA) on February 17, 2011 (ARCADIS 2011a).

As stated in the *Work Plan*, USEPA requested the collection of sub-slab soil vapor, indoor air, and ambient air samples from certain residential and commercial properties located on Olympia Avenue, Oregon Avenue, and Marietta Street (Study Area). The Residence is one of the properties that USEPA identified for study. The *Work Plan* was submitted to and approved by USEPA to establish the sampling methods and procedures to be followed. The objectives of the sampling were to:

- Measure concentrations of volatile organic compounds (VOCs) in sub-slab soil vapor and indoor air at each property identified for study by USEPA in the Study Area; and
- Measure concentrations of VOCs in outdoor air near these properties to evaluate atmospheric conditions at the time of indoor air sample collection.

The results of the second round of vapor intrusion sampling, sampling methodology, a discussion of the latest sampling results including a preliminary human health risk evaluation, and recommendations for future actions are provided below. A comparison of risks from both the first sampling round (April 21-22, 2011) and the current (second) sampling round (June 16-17, 2011) is also presented.

## **2. Sampling Program**

Consistent with the *Work Plan* (ARCADIS 2011a), ARCADIS collected a second round of sub-slab soil vapor, indoor air, and ambient air samples from the Residence on June 16-17, 2011. Specific sampling methodologies were consistent with the *Indoor Air Quality and Vapor Intrusion Assessment Scope of Work – Revision 2 (SOW)* (JCO 2010a), the *Quality Assurance Project Plan – Revision 1 (QAPP)* (JCO 2010b), and the

previous sampling round. Pre-sampling activities, sampling methodologies, and sample locations are described below. Sample logs are provided in Appendix A.

## **2.1 Pre-Sampling Activities**

Prior to sampling, ARCADIS, in coordination with USEPA, was granted access to the Residence from the current property owner. ARCADIS conducted a site reconnaissance to identify the building and foundation condition, building materials, heating, ventilation, and air conditioning (HVAC) operation, and potential preferential vapor migration pathways (i.e., sump pump, floor drains, cracks, etc.). To the extent feasible (the premises are leased to tenants), a product inventory was completed to list items observed in the building that may contain VOCs that could potentially interfere with sample results, and identified VOC-containing products that could be removed were taken out of the Residence prior to sampling.

During the building survey the following potential background sources were identified:

- Cleaning products containing bleach were noted in the home during the site visit, which may be a source of chloroform via reactions with other cleaning products (Odabasi 2008).
- Spray paint canisters were noted during the building survey. These could contain toluene and xylene.
- Various other cleaning products and aerosols were also noted during the product inventory.

Since indoor air sampling was conducted in both the basement and the first floor, the survey was conducted on both floors. All products found in the basement and first floor were containerized and removed from the home approximately 48 hours prior to sampling. The building survey and product inventory can be found in Appendix B.

## **2.2 Indoor Ambient Air Assessment**

On June 16, 2011, indoor air samples were collected from two locations in the basement level of the Residence and one location in the first floor. Indoor air samples collected in the basement were co-located with the installed sub-slab soil vapor points and were consistent with the previous round of sampling. The basement of the Residence was furnished as a den / family room and is likely not occupied full time.

Consistent with the *Work Plan*, an indoor air sample was collected from the first floor to ensure the primary living space was evaluated.

Sample methods were consistent with the *SOW* (JCO 2010a) and *QAPP* (JCO 2010b). Samples were collected from the breathing zone (3 to 4 feet above ground surface) above each sub-slab soil vapor location. To avoid any cross contamination issues with potential vapors under the floor slab, indoor air samples were collected prior to sub-slab soil vapor samples. To ensure a reasonable worst case scenario, indoor air sampling was conducted with all exterior building doors closed to avoid any dilution with outside air.

Samples were collected over a 24-hour period in individually certified six-liter passivated sample canisters provided by Alpha Analytical, Inc. of Mansfield, Massachusetts (Alpha), a National Environmental Laboratory Accreditation Conference (NELAC) (E87814) certified laboratory. Canisters were analyzed for VOCs by USEPA Method TO-15 featuring selective ion monitoring (SIM). Detailed sample collection methods are included in the *SOW* (JCO 2010a) and in SOP-JCO-063 contained in the *QAPP* (JCO 2010b). Sample logs from indoor air sampling are included in Appendix A.

### **2.3 Outdoor Ambient Air Assessment**

On June 16, 2011, one outdoor air sample was collected from an upwind location outside the Residence using the same methods as described for indoor air samples. The sample was collected to understand what contribution the ambient environment may have on indoor air samples collected from inside the building. Sample locations are presented in Figure 1. The outdoor ambient air and indoor air samples were collected over approximately the same 24-hour time period with the outdoor sample being started immediately prior to the indoor air samples. Sample logs from ambient air sampling are included in Appendix A.

### **2.4 Sub-Slab Soil Vapor Assessment**

Two permanent sub-slab soil vapor sample points were installed in the basement of the Residence on April 20, 2011 (Figure 1). Installation methods for the two points were previously reported in the *Work Plan* and the Indoor Air Quality and Vapor Intrusion Assessment (ARCADIS 2011a, b).

At the completion of the indoor air sampling on June 17, 2011, sub-slab soil vapor samples were collected from two locations in the Residence. The integrity of each

sample port was tested using a helium tracer test. These methods were presented in the *Work Plan* (ARCADIS 2011a).

Prior to sampling, three volumes of the sample tubing were purged utilizing a low-flow pump to remove any ambient air from the sampling train. Detailed methods for sampling are included in SOP-JCO-062 contained in the *QAPP* (JCO 2010b). Samples were collected over a 30-minute period in individually certified six-liter passivated sample canisters provided by Alpha. Canisters were analyzed for VOCs by USEPA Method TO-15 featuring SIM. Sample logs from sub-slab soil vapor sampling are included in Appendix A.

Upon the completion of the second round of sub-slab soil vapor sampling (June 17, 2011) the sub-slab soil vapor points were removed. Points were removed from the floor slab using a chisel, hammer, and pry-bar. After removing each sampling point, the drilled hole was vacuumed out and filled with hydraulic cement. The overlying carpeting was glued back down using low-VOC carpet adhesive.

## 2.5 Data Synthesis and Reporting

Analytical data packages generated by the laboratory were validated by Phoenix Chemistry Services according to national guidelines for tier III data validation as described in the *SOW* (JCO 2010a) and *QAPP* (JCO 2010b). The data review included: field documentation, proper holding times, proper chain-of-custody documentation, achievement of target reporting limits, acceptable laboratory calibrations and quality control parameters, and representativeness of duplicate results.

Findings of the validation effort resulted in the following qualifications of sample results:

- Results for naphthalene and 1,3-butadiene in all samples were qualified as estimated (J, UJ).
- Positive results greater than the sample-specific (adjusted) quantitation limit but less than the action limit (at twice the detected concentration) for methylene chloride in samples OA-1, IA-1, IA-2, IA-3, and SS-1, and for toluene in SS-1 were qualified as less than the reported value (U).



Quality control results, including any revisions or qualifiers deemed necessary, are included in Tables 1 and 2. The data validation report is included in Appendix C. The laboratory analytical data package is included in Appendix D.

### **3. Results and Discussion**

This section presents results for indoor air, outdoor ambient air, and sub-slab soil vapor samples collected from the Residence including a summary evaluation of potential human health risks. A copy of the complete Preliminary Human Health Risk Evaluation can be found in Appendix E.

#### **3.1 Indoor and Outdoor Ambient Air Sampling Results**

Analytical data for indoor and outdoor ambient air samples are presented on Table 1. The following compounds were detected in all three indoor air samples: 1,2,4-trimethylbenzene, 1,2-dichloroethane, benzene, carbon tetrachloride, chloroform, ethylbenzene, naphthalene, toluene, and xylenes. Detected concentrations of these constituents are presented in Table 1.

The following constituents were detected in the outdoor ambient air sample: 1,2,4-trimethylbenzene, benzene, carbon tetrachloride, chloroform, ethylbenzene, naphthalene, toluene, and xylenes. Detected concentrations of these constituents are presented in Table 1.

A comparison of the data indicates that several constituents were detected in both outdoor and indoor air. 1,2,4-Trimethylbenzene, benzene, carbon tetrachloride, chloroform, naphthalene, and toluene were measured at similar concentrations in indoor and outdoor air. Although ethylbenzene and xylenes were detected in both outdoor and indoor air, concentrations were slightly greater in indoor air compared to outdoor ambient air.

#### **3.2 Sub-Slab Soil Vapor Sampling Results**

Analytical data for sub-slab soil vapor are presented in Table 2. The following compounds were detected in both sub-slab soil vapor samples: 1,1,1-trichloroethane, chloroform, and PCE. Several constituents were only detected in one sub-slab soil vapor sample. 1,2,4-Trimethylbenzene, carbon tetrachloride, and xylenes were detected only in SS-1; no chemicals were detected only in sample SS-2. The full list of detected constituents and their concentrations are presented in Table 2.

### **3.3 Evaluation of Indoor Air and Sub-Slab Soil Vapor Results**

The data results for indoor air and sub-slab soil vapor were evaluated together to determine if indoor air samples were associated with a potential background source. As a first step, attenuation factors (AFs) were calculated to evaluate if chemicals present in indoor air are potentially associated with sub-slab soil vapor levels, or if chemicals may be attributable to background sources. The AF is the ratio of indoor air to sub-slab soil vapor results and was calculated when a constituent was detected in both indoor air and sub-slab soil vapor. AFs close to or greater than one indicate that indoor air concentrations are equal to or higher than sub-slab soil vapor concentrations and therefore, that a background source likely is present. Of the nine chemicals detected in indoor air, AFs could be calculated for four. All four chemicals had AFs close to or greater than one: 1,2,4-trimethylbenzene, carbon tetrachloride, chloroform, and xylenes. As a result, the presence of these chemicals in indoor air is attributable to background sources and not soil vapor intrusion. The calculation of AFs is presented in Table 2 of Appendix E.

Second, the data were evaluated to identify constituents that were detected in indoor air, but not in sub-slab soil vapor. These results indicate a background material is the only source of the detected indoor air concentrations. The following constituents were identified as having background sources based on this criterion: 1,2-dichloroethane, benzene, ethylbenzene, naphthalene, and toluene.

Third, the results of indoor air and outdoor air samples were compared. 1,2,4-trimethylbenzene, benzene, carbon tetrachloride, naphthalene, and toluene were measured at similar concentrations in both outdoor and indoor air. These results indicate background sources are present in outdoor ambient air.

Although PCE was detected in sub-slab soil vapor, it was not detected in any indoor air samples.

According to MADEP, when constituents of concern are measured in indoor air at levels that are below TVs, it can reasonably be concluded that a complete vapor intrusion pathway does not exist.

### **3.4 Residence Human Health Risk Evaluation**

Preliminary human health risk calculations were performed using the June 2011 validated indoor air data and a combined data set (i.e., average indoor concentrations)

from the April 2011 and June 2011 sampling events. The Preliminary Human Health Risk Evaluation Report and supporting calculations can be found in Appendix E. The conclusions from that report are summarized below.

Potential risks from inhalation of constituents detected in indoor air were calculated assuming a homebound individual lives in the Residence for 24 hours per day, 350 days per year, for 30 years. For each constituent, the exposure point concentration in indoor air is equal to the average concentration of the three indoor air results from the current sampling round. To evaluate potential risks over the initial (April 2011) and current (June 2011) sampling event, risks were calculated considering chemicals detected in indoor air from both sampling rounds. Data from April 21 and 22, 2011 were presented in the Indoor Air Quality and Vapor Intrusion Assessment: Report of Results submitted to USEPA on May 23, 2011 (ARCADIS 2011b). Any constituent that was detected in either the April or June sampling event in indoor air was included in the combined risk calculation. Risks were estimated using the average concentration from both sampling rounds. Risks associated with both data sets are referred to as “Combined Results” below.

The estimated total cancer risk associated with long term residential exposure to indoor air in the basement and on the first floor of the Residence from the June 2011 sampling round is  $1 \times 10^{-5}$ , primarily due to the presence of 1,2-dichloroethane, benzene, chloroform, carbon tetrachloride, and naphthalene (97% of risk). PCE was not detected in indoor air collected during the current sampling round.

The estimated total cancer risk associated with long term residential exposure to indoor air in the basement and first floor of the Residence using the combined data set is  $1 \times 10^{-5}$ , primarily due to the presence of 1,2-dichloroethane, 1,3-butadiene, benzene, chloroform, and naphthalene (84% of risk). The majority of risk associated with 1,2-dichloroethane, 1,3-butadiene, benzene, chloroform, and naphthalene is likely from background sources. Excluding these five chemicals, all other chemical-specific risks are equal to or below a  $1 \times 10^{-6}$  risk level for the combined data set. Estimated cancer risk from PCE using the combined data set is equal to  $5 \times 10^{-7}$ .

#### **4. Summary and Conclusions**

The estimated total risk, including exposure to constituents in the Residence originating from background sources is  $1 \times 10^{-5}$ , primarily due to 1,2-dichloroethane, benzene, carbon tetrachloride, chloroform, and naphthalene. As noted above, PCE was not detected in indoor air in the June 2011 sampling event. The estimated cancer risk for

PCE in the combined data results is equal to  $5 \times 10^{-7}$ . The overall risk levels for June 2011 and the combined data are both equal to  $1 \times 10^{-5}$ .

All measured concentrations of VOCs were below the MADEP TVs. According to MADEP, when constituents of concern are measured in indoor air at levels that are below TVs, it can reasonably be concluded that a complete vapor intrusion pathway does not exist.

## **5. Recommendations**

The two rounds of sub-slab soil vapor and indoor air data collected in April and June 2011 from the basement and first floor of the Residence confirm that risks to residents are within USEPA's risk range for Superfund sites. Estimated risks from exposure to constituents detected in indoor air are due primarily to background sources from products used and stored in the Residence. PCE was not detected in the current sampling round. Estimated risk from exposure to PCE based on the combined data is equal to  $5 \times 10^{-7}$  which is less than USEPA's risk range for Superfund sites. Based on these findings, no further action is recommended to address the vapor intrusion pathway at the Residence.

## **6. References**

ARCADIS. 2011a. Vapor Intrusion Assessment Work Plan: Off-Site Sub-slab and Indoor Air Evaluation, Wells G&H Superfund Site, Woburn, Massachusetts. January 7.

ARCADIS. 2011b. Indoor Air Quality and Vapor Intrusion Assessment: Report of Results. Residence, Parcel 26/ 05/ 05 – North, Wells G&H Superfund Site, Woburn, Massachusetts. April 2011.

Dawson, Helen. 2008. Background Indoor Air Concentrations of Volatile Organic Compounds in North American Residences. Literature Review & Implications for Vapor Intrusion Assessment. Vapor Intrusion Workshop – AEHS Spring 2008, San Diego, California.

Massachusetts Department of Environmental Protection (MADEP). 2008. Indoor Air Threshold Values for the Evaluation of a Vapor Intrusion Pathway, Technical Update, Draft. June 26.



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Odabasi, M. 2008. Halogenated Volatile Organic Compounds from the Use of Chlorine-Bleach-Containing Household Products. Environ. Sci. Technol. 42:1445-1451.

The Johnson Company (JCO). 2010a. Indoor Air Quality and Vapor Intrusion Assessment Scope of Work, Revision 2, UniFirst Property, Wells G&H Superfund Property. March 25.

JCO. 2010b. Quality Assurance Project Plan, Revision 1, Indoor Air Quality and Vapor Intrusion Assessment, UniFirst Property, Wells G&H Superfund Property. March 25.

**Table 1. Residential Indoor and Ambient Air Data**

Sample Name: Location: Date Collected:	Units	IA-1 Basement 6/17/2011	IA-2 Basement 6/17/2011	IA-3 1st Floor 6/17/2011	OA-1 Outdoor 6/17/2011
1,1,1-Trichloroethane	µg/m <sup>3</sup>	0.109 U	0.109 U	0.109 U	0.109 U
1,1,2-Trichloroethane	µg/m <sup>3</sup>	0.109 U	0.109 U	0.109 U	0.109 U
1,1-Dichloroethane	µg/m <sup>3</sup>	0.081 U	0.081 U	0.081 U	0.081 U
1,1-Dichloroethene	µg/m <sup>3</sup>	0.079 U	0.079 U	0.079 U	0.079 U
1,2,4-Trimethylbenzene	µg/m <sup>3</sup>	0.256	0.256	0.177	0.226
1,2-Dibromoethane	µg/m <sup>3</sup>	0.154 U	0.154 U	0.154 U	0.154 U
1,2-Dichloroethane	µg/m <sup>3</sup>	0.202	0.162	0.461	0.081 U
1,2-Dichloropropane	µg/m <sup>3</sup>	0.092 U	0.092 U	0.092 U	0.092 U
1,3-Butadiene	µg/m <sup>3</sup>	0.044 UJ	0.044 UJ	0.044 UJ	0.044 UJ
1,3-Dichlorobenzene	µg/m <sup>3</sup>	0.12 U	0.12 U	0.12 U	0.12 U
1,4-Dichlorobenzene	µg/m <sup>3</sup>	0.12 U	0.12 U	0.12 U	0.12 U
Benzene	µg/m <sup>3</sup>	0.316	0.345	0.278	0.249
Bromodichloromethane	µg/m <sup>3</sup>	0.134 U	0.134 U	0.134 U	0.134 U
Bromoform	µg/m <sup>3</sup>	0.207 U	0.207 U	0.207 U	0.207 U
Carbon Tetrachloride	µg/m <sup>3</sup>	0.421	0.465	0.459	0.472
Chlorobenzene	µg/m <sup>3</sup>	0.092 U	0.092 U	0.092 U	0.092 U
Chloroform	µg/m <sup>3</sup>	0.234	0.2	0.137	0.107
cis-1,2-Dichloroethene	µg/m <sup>3</sup>	0.079 U	0.079 U	0.079 U	0.079 U
Ethylbenzene	µg/m <sup>3</sup>	0.478	0.456	0.195	0.13
Isopropylbenzene	µg/m <sup>3</sup>	2.46 U	2.46 U	2.46 U	2.46 U
Methylene Chloride	µg/m <sup>3</sup>	2.17 U	1.78 U	3.35 U	2.76 U
Methyl tert-butyl ether	µg/m <sup>3</sup>	0.072 U	0.072 U	0.072 U	0.072 U
Naphthalene	µg/m <sup>3</sup>	0.162 J	0.189 J	0.136 J	0.304 J
Tetrachloroethene	µg/m <sup>3</sup>	0.136 U	0.136 U	0.136 U	0.136 U
Toluene	µg/m <sup>3</sup>	2.32	1.86	1.2	1.27
trans-1,2-Dichloroethene	µg/m <sup>3</sup>	0.079 U	0.079 U	0.079 U	0.079 U
trans-1,3-Dichloropropene	µg/m <sup>3</sup>	0.091 U	0.091 U	0.091 U	0.091 U
Trichloroethene	µg/m <sup>3</sup>	0.107 U	0.107 U	0.107 U	0.107 U
Vinyl Chloride	µg/m <sup>3</sup>	0.051 U	0.051 U	0.051 U	0.051 U
Xylenes (total)	µg/m <sup>3</sup>	0.96	0.947	0.617	0.491

**Notes:**

J - The value given is estimated

U - Constituent not detected

µg/m<sup>3</sup> - Micrograms per cubic meter

IA - Indoor air sample

OA - Ambient air sample

**Table 2. Residential Sub-slab Soil Vapor Data**

Sample Name: Location: Date Collected:	Units	SS-1 Sub-Slab 6/17/2011	SS-2 Sub-Slab 6/17/2011
1,1,1-Trichloroethane	µg/m <sup>3</sup>	0.273	0.153
1,1,2-Trichloroethane	µg/m <sup>3</sup>	0.109 U	0.109 U
1,1-Dichloroethane	µg/m <sup>3</sup>	0.081 U	0.081 U
1,1-Dichloroethene	µg/m <sup>3</sup>	0.079 U	0.079 U
1,2,4-Trimethylbenzene	µg/m <sup>3</sup>	0.221	0.098 U
1,2-Dibromoethane	µg/m <sup>3</sup>	0.154 U	0.154 U
1,2-Dichloroethane	µg/m <sup>3</sup>	0.081 U	0.081 U
1,2-Dichloropropane	µg/m <sup>3</sup>	0.092 U	0.092 U
1,3-Butadiene	µg/m <sup>3</sup>	0.044 UJ	0.044 UJ
1,3-Dichlorobenzene	µg/m <sup>3</sup>	0.12 U	0.12 U
1,4-Dichlorobenzene	µg/m <sup>3</sup>	0.12 U	0.12 U
Benzene	µg/m <sup>3</sup>	0.224 U	0.224 U
Bromodichloromethane	µg/m <sup>3</sup>	0.134 U	0.134 U
Bromoform	µg/m <sup>3</sup>	0.207 U	0.207 U
Carbon Tetrachloride	µg/m <sup>3</sup>	0.145	0.126 U
Chlorobenzene	µg/m <sup>3</sup>	0.092 U	0.092 U
Chloroform	µg/m <sup>3</sup>	0.22	0.166
cis-1,2-Dichloroethene	µg/m <sup>3</sup>	0.079 U	0.079 U
Ethylbenzene	µg/m <sup>3</sup>	0.087 U	0.087 U
Isopropylbenzene	µg/m <sup>3</sup>	2.46 U	2.46 U
Methylene Chloride	µg/m <sup>3</sup>	3.02 U	1.74 U
Methyl tert-butyl ether	µg/m <sup>3</sup>	0.072 U	0.072 U
Naphthalene	µg/m <sup>3</sup>	0.262 UJ	0.262 UJ
Tetrachloroethene	µg/m <sup>3</sup>	73.9	145
Toluene	µg/m <sup>3</sup>	0.686 U	0.188 U
trans-1,2-Dichloroethene	µg/m <sup>3</sup>	0.079 U	0.079 U
trans-1,3-Dichloropropene	µg/m <sup>3</sup>	0.091 U	0.091 U
Trichloroethene	µg/m <sup>3</sup>	0.107 U	0.107 U
Vinyl Chloride	µg/m <sup>3</sup>	0.051 U	0.051 U
Xylenes (total)	µg/m <sup>3</sup>	0.386	0.261 U

**Notes:**

J - The value given is estimated.

U - Constituent not detected

µg/m<sup>3</sup> - Micrograms per cubic meter

SS - Sub-slab soil vapor sample



⊕ SAMPLING LOCATION  
⊕ HOT WATER HEATER

1. ALL LOCATIONS ARE APPROXIMATE.  
2. NOT TO SCALE.

## RESIDENCE SAMPLE LOCATIONS - JUNE 2011







## **Appendix A**

Sampling Logs



## Indoor Air Sample Collection Log

Sample ID:		AA-570-1-06162011	
Client:	UniFirst	Outdoor/Indoor:	Outdoor
Project:	Wells G&H	Sample Intake Height:	4'
Location:	Woburn, MA	Tubing Information:	—
Project #:	MA000989-0002-00023	Miscellaneous Equipment:	—
Samplers:	M. Jackson	Time On/Off:	0950
Sample Point Location:	upwind of <span style="color: blue;">REDACTED</span>	Subcontractor:	—

### Instrument Readings:

Date	Time	Canister Vacuum (a) (Inches of Hg)	Temperature (°F or °C)	Relative Humidity (%)	Air Speed (ft/min)	Barometric Pressure (Inches of Hg)	PID (ppb)
6/16/2011	0950	-30"	81°F	58%	0.2 mph	29.77	—
6/17/2011	0902	-7"	77°F	65%	0.5 mph	29.84	
6/17/2011	0952	-6.3"					

(a) Record canister information at a minimum at the beginning and end of sampling

### SUMMA Canister Information:

Size (circle one):	1 L <span style="border: 1px solid black; border-radius: 50%; padding: 2px;">6 L</span>
Canister ID:	995
Flow Controller ID:	481
Notes:	

### General Observations/Notes:

• Placed canister in same location as Round One.
• Canister upwind of <span style="color: blue;">REDACTED</span>
• wind from west both 6/16 and 6/17



# Indoor Air Sample Collection Log

		Sample ID:	IA-70-1-06162011
Client:	UniFirst	Outdoor/Indoor:	indoor
Project:	Wells G&H	Sample Intake Height:	4'
Location:	Woburn, MA	Tubing Information:	—
Project #:	MA000989 0002-0003	Miscellaneous Equipment:	—
Samplers:	Wholesman	Time On/Off:	1001
Sample Point Location:	REDACTED Basement North	Subcontractor:	—

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F or °C)	Relative Humidity (%)	Air Speed (ft/min)	Barometric Pressure (inches of Hg)	PID (ppb)
06/16/2011	1001	-30"	77°F	61%	—	29.77	
6/17/2011	0905	-7.1"					
6/17/2011	0958	-6.25"	77°F	66%	—	29.85	

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA Canister Information:**

Size (circle one):	1 L	6 L
Canister ID:	901	
Flow		
Controller ID:	131	
Notes:		

**General Observations/Notes:**




## Indoor Air Sample Collection Log

Client: UniFirst		Sample ID: IA-70-2-06162011
Project: Wells G&H		Outdoor/Indoor: Indoor
Location: Woburn, MA		Sample Intake Height: 5'
Project #: MA000989.0002.00003		Tubing Information: —
Samplers: Wackesman		Miscellaneous Equipment: —
Sample Point Location: REDACTED		Time On/Off: 0959
Basement, New Closet		Subcontractor: —

### Instrument Readings:

Date	Time	Canister Vacuum (a) (Inches of Hg)	Temperature (°F or °C)	Relative Humidity (%)	Air Speed (ft/min)	Barometric Pressure (Inches of Hg)	PID (ppb)
06/16/2011	0959	-24.8"	78°F	56%	0	29.77	—
6/17/2011	0906	-6.1"	77°F				
6/17/2011	0957	-5.2"	<del>77°F</del> 77°F	66%		29.85	

(a) Record canister information at a minimum at the beginning and end of sampling

### SUMMA Canister Information:

Size (circle one):	1 L <u>6 L</u>
Canister ID:	1614
Flow Controller ID:	229
Notes:	

### General Observations/Notes:

Despite Being Asked to keep windows closed during sampling, windows were open



## Indoor Air Sample Collection Log

Sample ID:		IA-70-3-06162011	
Client:	Un, First	Outdoor/Indoor:	Indoor
Project:	Wells G & H	Sample Intake Height:	4'
Location:	Woburn, MA	Tubing Information:	—
Project #:	MA000989.0002.0003	Miscellaneous Equipment:	—
Samplers:	McNackson	Time On/Off:	0953
Sample Point Location:	REDACTED, First Floor	Subcontractor:	—

### Instrument Readings:

Date	Time	Canister Vacuum (a) (Inches of Hg)	Temperature (°F or °C)	Relative Humidity (%)	Air Speed (ft/min)	Barometric Pressure (Inches of Hg)	PID (ppb)
6/16/2011	0953	-30"	83°F	50%	0	29.76	—
6/17/2011	0905	-9"					
	0954	-8.1"	77°F	64.5%	0	29.84	

(a) Record canister information at a minimum at the beginning and end of sampling

### SUMMA Canister Information:

Size (circle one):	1 L (6 L)
Canister ID:	648
Flow Controller ID:	129
Notes:	

### General Observations/Notes:




## Subslab Soil Vapor Sample Collection Log

Client:	UniFirst	Sample ID:	SS-70-1-06172011
Project:	Wells G&H	Boring Equipment:	None
Location:	Woburn, MA	Sealant:	Teflon hydraulic cement
Project #:	MA000989.0002.00003	Tubing Information:	Teflon
Samplers:	M. Warkentin	Miscellaneous Equipment:	Purge pump
Sample Point Location:	REDACTED	Subcontractor:	None
Sampling Depth:	3 inches below slab	Equipment:	—
Time and Date of Installation:	4/20/2011	Moisture Content of:	Dry
		Approximate Purge Volume:	1 minute @ 50 ml/min

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F or °C)	Relative Humidity (%)	Air Speed (ft/min)	Barometric Pressure (inches of Hg)	PID (ppb)
6/17/2011	1049	-29.7"					
	1112	-10.5"					
	1119	-5.4"	73°F	76%	0	24.83	

(a) Record canister information at a minimum at the beginning and end of sampling

### SUMMA Canister Information:

Size (circle one):	1 L (6 L)
Canister ID:	1672
Flow Controller ID:	243
Notes:	

### Tracer Test Information (if applicable):

Initial Helium Shroud:	72%
Final Helium Shroud:	70%
Tracer Test Passed:	Yes No
Notes:	Oppm in purge Air

### General Observations/Notes:


### Approximating One-Well Volume (for purging):

When using 1¼-inch "Dummy Point" and a 6-inch sampling interval, the sampling space will have a volume of approximately 150 mL. Each foot of ¼-inch tubing will have a volume of approximately 10 mL.





# Subslab Soil Vapor Sample Collection Log

Client: UniFirst		Sample ID: SS-70-2-06172011
Project: walls G & H		Boring Equipment: None
Location: Woburn, MA		Sealant: hydraulic cement
Project #: MA000989.0002.0003		Tubing Information: Teflon
Samplers: M. Wackman		Miscellaneous Equipment: purge pump
Sample Point Location: REDACTED Basement, North wall		Subcontractor: None
Sampling Depth: REDACTED 3 inches below slab		Equipment: —
Time and Date of Installation: 4/20/2011 10 am		Moisture Content of: Dry
		Approximate Purge Volume: 1 minute @ 50 ml/min

## Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F or °C)	Relative Humidity (%)	Air Speed (ft/min)	Barometric Pressure (inches of Hg)	PID (ppb)
6/17/2011	1124	-29.3"					
	1137	-18.8	73°F	76%	0	29.83	
	1154	-6.4					

(a) Record canister information at a minimum at the beginning and end of sampling

## SUMMA Canister Information:

Size (circle one):	1 L (6 L)
Canister ID:	1669
Flow Controller ID:	363
Notes:	

## Tracer Test Information (if applicable):

	Initial Test	Re-test
Initial Helium Shroud:	60%	57%
Final Helium Shroud:	76%	51%
Tracer Test Passed:	Yes	(No)
Notes:	12,000 ppm in purge	

Passed on second test!

## General Observations/Notes:

Added clay and will re-test - Oppum in Purge


## Approximating One-Well Volume (for purging):

When using 1¼-inch "Dummy Point" and a 6-inch sampling interval, the sampling space will have a volume of approximately 150 mL. Each foot of ¼-inch tubing will have a volume of approximately 10 mL.



## **Appendix B**

Building Survey and Product  
Inventory Field Form



Indoor Air Quality Building Survey

Sampler: Mitch Wackerman Date: 6/14/2011 JCO #: \_\_\_\_\_

Address: REDACTED

Woburn, MA  
REDACTED

Contact Name: \_\_\_\_\_

List of Current Occupants/Occupation:

Age (if under 18)	Sex (m/f)	Occupation
Adult	M	Sheet Metal Installer
	F	
	F	
	F	
Child	M	

Building Construction Characteristics:

What type of building is it? (Circle appropriate responses)

Single Family ☒ Multi-Family ☐ School ☐ Commercial ☐ Industrial ☐

Ranch ☐ 2-Family ☐  
Raised Ranch ☐ Duplex ☒  
Cape ☐ Apartment House (# of units 2)  
Colonial ☐ Condominium (# of units \_\_\_\_\_)  
Split Level ☐ Other (specify) \_\_\_\_\_  
Mobile Home ☐

General description of building construction materials: Finished basement & 2 stories  
poured walls

Number of occupied stories: 3 Year built? 1985

Has the building been weatherized with any of the following? (Circle all that apply)

Insulation ☐ Storm windows ☐ Energy-efficient windows ☐ Other (specify) \_\_\_\_\_

Attached garage? (Y/N) N Vehicle(s) present? (Y/N) \_\_\_\_\_

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What type of basement does the building have? (Circle all that apply)

Full basement

Crawlspace

Slab-on-grade

Other (specify)

What are the characteristics of the basement? (Circle all that apply)

Finished

Unfinished

Partially finished (%)

Basement Floor:Concrete

Dirt

Other (specify)

Foundation Walls:Poured concrete

Block

Field stone

Moisture:

Wet

Damp

Dry

Is a basement sump present? (Y/N) N French drain Outside Is sump sealed to indoor air? (Y/N) \_\_\_\_\_

Does the basement have any of the following characteristics (e.g., preferential vapor pathways) that might permit soil vapor entry? (Circle all that apply) Carpeted

Cracks

Pipe/utility conduits

Other (specify)

Foundation/slab drainage

Sump pumps

↳ outside**Heating and Ventilation System(s) Present:**

What types of heating system(s) are used in this building? (Circle all that apply)

Hot air circulation

Heat pump

Steam Radiation

Wood stove

Other (specify) Air conditioner (central/window)

Fireplace (wood/gas)

Baseboard Electric

What types of fuels are used in this building? (Circle all that apply)

Natural gas

Electric

Coal

Other (specify)

Fuel oil

Wood

Solar

What type of mechanical ventilation systems are present and/or currently operating in this building?

(Circle all that apply)

Central air conditioning

Mechanical fans

Bathroom vent fan

Individual air conditioning

Kitchen range hood

Air-to-air heat exchanger

Open windows

Other (specify)

**Sources of Chemical Contaminants:**

Source: MaDEP, 2002, "Indoor Air Sampling and Evaluation Guide, WSC Policy #02-430", Office of Research and Standards, Massachusetts Department of Environmental Protection, April, 2002.

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Which of these are present in the building?

Potential VOC Source	Location of Source	Major Ingredients	Removed Prior to Air Sampling (Y/N/NA)
Paint or paint thinners	Basement	Water Based	Yes
Gas-powered equipment			
Gasoline storage cans			
Cleaning solvents			
Air fresheners	Basement	See product inventory	Yes
Oven cleaners			
Carpet/ upholstery cleaners	Basement	See product inventory	Yes
Hairspray			
Nail polish/ remover			
Bathroom cleaner	Basement & 1st Floor	See product inventory	Yes
Appliance cleaner	Basement & 1st Floor	See product inventory	Yes
Furniture/ floor polish	Basement & 1st Floor	See product inventory	Yes
Moth balls			
Fuel oil tank			
Wood stove			
Fireplace			
Perfume/ colognes			
Hobby supplies			
Scented potpourri, etc	Basement & 1st Floor	See product inventory	Yes
Brake cleaner			
Liquid Wrench			
Other			
Other			
Other			

Do one or more smokers occupy this building on a regular basis? NO

Has anyone smoked in the building in the last 48 hours? (Y/N) N

Do the occupants frequently have clothes dry-cleaned? (Y/N) N

Any recent remodeling or repainting (Y/N, describe) N

Any obvious pressed wood products (e.g. hardwood plywood paneling, particleboard, fiberboard)? (Y/N) N

Are there any new upholstery, drapes, carpets, or other textiles? (Y/N) N

Source: MaDEP, 2002, "Indoor Air Sampling and Evaluation Guide, WSC Policy #02-430", Office of Research and Standards, Massachusetts Department of Environmental Protection, April, 2002.

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Page 4 of 4

Has the building been treated with any insecticides/pesticides? If so, how often and what chemicals were used? Not in last few years

Do any of the occupants apply pesticides/herbicides in the yard or garden? If so, how often and what chemicals are used? Yes, unknown how often

**Outdoor Sources of Contamination:**

Is there any stationary emission source in the vicinity of the building? Oil Furnace

Are there any mobile emission sources (e.g., highway; bus stop; high-traffic area) in the vicinity of the building?

Highways 93 & 95

**Weather Conditions During Sampling:**

Outside Temperature (°F): 75-80°F

Prevailing wind direction: West to East

Describe the general weather conditions (e.g., sunny, cloudy, rain):

Warm & Sunny

Was there any significant precipitation (0.1 inches) within 12 hours preceding the sampling event? no

Type of ground cover (e.g., grass, pavement, etc.) outside the building: pavement

**General Comments**

Is there any other information about the structural features of this building, the habits of its occupants or potential sources of chemical contaminants to the indoor air that may be of importance in facilitating the evaluation of the indoor air quality of the building?

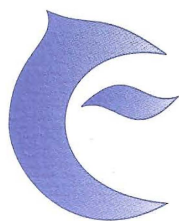
## Chemical Inventory - 26/05/05 - North

Name	Ingredient(s)	Removed?
Rustoleum Bright Coat Metallic Finish	See MSDS	Yes
Maintenance Pro Cleanser w/Chlorine Bleach	See MSDS	Yes
Bissell Pet Carpet & Upholstery Cleaner	See MSDS	Yes
Hot Shot Flying Insect Cleaner	See MSDS	Yes
Off Insect Repellant Spray	See MSDS	Yes
Suspend SC Insecticide	See MSDS	Yes
Color Place Spray Paint	See MSDS	Yes
Krylon Triple Thick Crystal Clear Glaze No. 0500	See MSDS	Yes
Zep 45 Penetrating Lubricant with Teflon spray	See MSDS	Yes
enamel paint	See MSDS	Yes
Powerhouse Non-abrasive Bathroom Cleaner aerosol	See MSDS	Yes
Rid-X Professional Septic System Treatment	See MSDS	Yes
plug-in air freshener	See MSDS	Yes
LA's Total Awesome Cleaner spray	See MSDS	Yes
Mr. Clean liquid	See MSDS	Yes
Zep Stainless Steel Cleaner Professional Strength aerosol	See MSDS	Yes
glass cleaner	See MSDS	Yes
bathroom and shower cleaner	See MSDS	Yes
Scotchgard Carpet Protector	See MSDS	Yes
Foot Locker Sneaker Protector	See MSDS	Yes
Powerhouse Furniture Polish	See MSDS	Yes
Tarn-x Polish	See MSDS	Yes
Glade Tough Odor Solutions spray	See MSDS	Yes
Air Freshener	See MSDS	Yes
Dish Soap	See MSDS	Yes
Cascade Dish Soap	See MSDS	Yes
Mr. Clean Scrubbing Pads	See MSDS	Yes
Foot Locker Instant Sneaker Cleaner	See MSDS	Yes
Armor All	See MSDS	Yes
Mainstays Odor-Neutralizing Spray	See MSDS	Yes
Cerma Bryte	See MSDS	Yes
Weiman Cook Top Cleaner	See MSDS	Yes
Street Appeal Auto Protectant	See MSDS	Yes
Oxy Canvas and Awning	See MSDS	Yes
Market Basket Wet Cleaning Cloths	See MSDS	Yes
Spa Collection Vanilla and Cream Liquid Potpourri	See MSDS	Yes
Pak-It Glass and Hard Surface Cleaner	See MSDS	Yes
Talstar Termiticide	See MSDS	Yes
Renuzit Super Odor Neutralizer	See MSDS	Yes
Gorilla Glue	See MSDS	Yes



## **Appendix C**

Data Validation Report



## Phoenix Chemistry Services

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Aug. 8, 2011

Nadine Weinberg  
ARCADIS, U.S., Inc.  
482 Congress Street, Suite 501  
Portland, ME 04101

Reference #s: 2011-0705-001 & -002, and 2011-0715-001 & -002

Dear Nadine,

Phoenix Chemistry Services has submitted four reports on August 4 - 5, 2011 presenting the results of the data validation of Sample Delivery Group (SD) Nos. L1108879, L1108880, L1108884, and L1108885 from the Indoor Air Quality/Vapor Intrusion (IAQ/VI) assessment work at several residential and/or commercial properties in Woburn, MA. The indoor and outdoor air and sub-slab vapor samples in these SDGs were collected June 16 - 18, 2011. The laboratory analyses were performed by Alpha Analytical Laboratories, Inc. of Mansfield, MA.

The data packages and electronic deliverables were received on July 5 and 15, 2011. Two separate data packages for the canister certifications (SDG Nos. L1108049 and L1108435), and associated files L1108879.pdf, L1108880.pdf, L1108884.pdf, L1108885A.pdf, and L1108885B.pdf were received on June 16, 2011. The validation has been performed by Phoenix Chemistry Services according to the Tier III guidelines as defined by USEPA Region I, as presented in "Region I EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses", December, 1996. The EPA's National Functional Guidelines for Organic Data Review (EPA 540/R-99/008, October, 1999), the IAQ/VI Quality Assurance Project Plan (QAPP), and the Field-Laboratory Coordination Memorandum (Phoenix Chemistry Services, March 25, 2010) were also considered during the evaluation, and professional judgment was applied as necessary and appropriate. Data qualifiers have been applied in the final validation report as necessary and appropriate, in accordance with these guidelines.

The samples in these four data packages were collected as a single sampling round, and utilized shared quality control (QC) samples, including two trip blanks, four outdoor air samples, four field duplicate pairs, and two laboratory replicates. The trip blanks and laboratory replicates were each logged in and reported in at least two data packages to avoid collecting redundant QC samples, as requested by the field engineer. Only one set of results for these QC samples was retained in the project database to avoid duplications; the earliest laboratory identifier was selected to be validated and reported. The laboratory is maintaining the original reporting packages.

A reporting error was noted in the clean canister certification package SDG No. L1108435; an incorrect copy of the initial calibration was included in the raw data section, and the continuing calibration presented incorrect percent difference values, as the compounds were evaluated against the incorrect initial calibration. The laboratory quickly responded to the validator's request for a copy of the missing initial calibration, however, a revision of the data package with the corrected continuing calibration has not yet been received (the validator performed the checks manually after receiving the correct initial calibration). The laboratory should be reminded that this is still outstanding.

Thank you for this opportunity to provide data validation services to ARCADIS. If there are any questions or concerns about the material in this report, please do not hesitate to contact me for help and clarification.

Sincerely,

Deborah H. Gaynor, Ph.D.  
Principal, Phoenix Chemistry Services

Phoenix Chemistry Services | 126 Covered Bridge Road | North Ferrisburg | Vermont | 05473

Telephone: (802) 233-2473 | Website: [www.phoenixchemistryservices.com](http://www.phoenixchemistryservices.com) | Email: [dgaynor@phoenixchemistryservices.com](mailto:dgaynor@phoenixchemistryservices.com)

**DATA VALIDATION**

**FOR**

**UniFirst-Woburn Vapor Intrusion Assessment  
Woburn, MA**

**ORGANIC ANALYSIS DATA  
Selected Volatiles in Air Samples**

**Sample Delivery Group (SDG) No.  
L1108879**

**Chemical Analyses Performed by:**

**Alpha Analytical Laboratories, Inc.  
320 Forbes Blvd.  
Mansfield, MA 02048**

**FOR**

**ARCADIS U.S., Inc.  
482 Congress Street, Suite 501  
Portland, ME 04101**

**Data Validation Report by:**

**Phoenix Chemistry Services  
126 Covered Bridge Rd.  
N. Ferrisburg, VT 05473  
(802) 233-2473  
Aug. 4, 2011**



### **EXECUTIVE SUMMARY**

Phoenix Chemistry Services (Phoenix) has completed the validation of the Method TO-15 Selected Ion Monitoring (SIM) volatiles in air analysis data prepared by Alpha Analytical Laboratories of Mansfield, MA, for 6 air samples and one (1) trip blank (TB) from a residential property in Woburn, MA. The laboratory reported the data under Sample Delivery Group (SDG) No. L1108879, which was submitted as a single data package received by Phoenix on July 4, 2011, and includes the following samples:

Sample ID	Laboratory ID
AA-57O-1-06162011	L1108879-01
IA-7O-3-06162011	L1108879-02
IA-7O-2-06162011	L1108879-03
IA-7O-1-06162011	L1108879-04
SS-7O-1-06162011	L1108879-05
SS-7O-2-06162011	L1108879-06
TB06172011	L1108879-07

A cross-reference table of sample IDs was provided in the data package. A separate data package, SDG No. L1108049, containing the supporting documentation (clean can certifications) for the preparation and analysis of the sampling canisters, and a file (L1108879.pdf) containing the raw data for the vacuum check upon receipt and the flow controller rate checks, were also submitted on June 16 and July 4, 2011, respectively.

The samples in this data set represent the indoor air and the sub-slab soil vapor samples (matched to the indoor sampling locations) collected from June 16 to 17, 2011 in Woburn, MA inside a residential building, and an ambient air sample collected outdoors at the sample location on June 16, 2011. All samples were kept in the engineer's custody after sampling until hand-delivered by laboratory courier to the laboratory on June 18, 2011.

Findings of the validation effort resulted in the following qualifications of sample results:

- Results for naphthalene and 1,3-butadiene in all samples were qualified as estimated (J, UJ).
- Positive results greater than the sample-specific (adjusted) quantitation limit but less than the action limit (at twice the detected concentration) for methylene chloride in samples AA-57O-1-06162011, IA-7O-3-06162011, IA-7O-2-06162011, IA-7O-1-06162011, and SS-7O-1-06172011, and for toluene in SS-7O-1-06172011 were qualified as less than the reported value (U).
- The laboratory appropriately applied "J" qualifiers to the CLP-like sample Form 1s when the concentration of an analyte was less than the sample-specific QL for the analytes naphthalene, 1,2-dibromoethane, and bromodichloromethane in the TO-15 SIM analysis. The validator did not remove these qualifiers.

The Overall Evaluation of Data (Section XVI) summarizes the validation results. The validation findings and conclusions for each analytical parameter are detailed in the remaining sections of this report.

Documentation problems observed in the data package are described in Section XVII.

This validation report shall be considered part of the data package for all future distributions of TO - 15 SIM (volatiles in air) analysis data for SDG No. L1108879.

## **INTRODUCTION**

Analyses of selected volatiles in air samples were performed according to Method TO-15, as modified for Selected Ion Monitoring (SIM) in the laboratory standard operating procedure (SOP) No. A-001, and in accordance with requirements in the Quality Assurance Project Plan (QAPP) for Indoor Air Quality and Vapor Intrusion Assessment, Rev. 2, March, 2010. The target compound list was limited to the compounds listed in Form K of the QAPP, and reporting limits are as specified there.

Tentative identification of non-target analyte peaks (i.e., tentatively identified compounds, or TICs) was not requested for these analyses.

Phoenix's validation was performed in conformance with Tier III guidelines as defined by USEPA Region I. Data qualifiers are applied as necessary and appropriate. To the extent possible, the data were evaluated in accordance with the "Region I EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses", December, 1996. EPA's National Functional Guidelines for Organic Data Review (EPA 540/R-94/012, 2/94) and the QAPP were also considered during the evaluation, and professional judgment was applied as necessary and appropriate.

The data validation process evaluates data on a technical basis for chemical analyses conducted under the USEPA Contract Laboratory Program (CLP) or other well-defined methods. Contract compliance is evaluated only in specific situations. Issues pertaining to contractual compliance are noted where applicable. It is assumed that the data package is presented in accordance with the CLP requirements. It is also assumed that the data package represents the best efforts of the laboratory and has already been subjected to adequate and sufficient quality review prior to submission for validation.

Results of sample analyses are reported by the laboratory as either qualified or unqualified; various qualifier codes are used by the laboratory to denote specific information regarding the analytical results. During the validation process, laboratory data are verified against all available supporting documentation. Based on this evaluation, qualifier codes may be added, deleted or modified by the data validator. Raw data is examined in detail to check calculations, compound identification, and/or transcription errors. Validated results are either qualified or unqualified; if results are unqualified, this means that the reported values may be used without reservation. Final validated results are annotated with the following codes, as defined in the EPA Region I Functional Guidelines:

- U - The analyte was analyzed for, but was not detected. The associated numerical value is the sample quantitation limit. The sample quantitation limit accounts for sample specific dilution factors and percent solids corrections or sample sizes that deviate from those required by the method.
- J - The associated numerical value is an estimated quantity.
- UJ - The analyte was analyzed for, but was not detected. The sample quantitation limit is an estimated quantity.
- R - The data are unusable (analyte may or may not be present). Resampling and reanalysis is necessary for verification. The R replaces the numerical value or sample quantitation limit.

In some instances (e.g., a dilution) a result may be indicated as “rejected” to avoid confusion when a more quantitatively accurate result is available.

EB, TB, BB - An analyte that was identified in an aqueous equipment (field) blank, trip blank, or bottle blank that was used to assess field contamination associated with soil/sediment samples. These qualifiers are to be applied to soil/sediment sample results only.

These codes are assigned during the validation process and are based on the data review of the results. They are recorded in the “Validator\_Qualifier” column, and are also found with the validated laboratory-applied qualifiers in the “Qualifier” column in the electronic spreadsheet contained in Attachment A.

All data users should note two facts. First, **the "R" qualifier means that the laboratory-reported value is completely unusable.** The analysis is invalid due to significant quality control problems, and provides no information as to whether the compound is present or not. Rejected values should not appear on data tables because they have no useful purpose under any circumstances. Second, **no analyte concentration is guaranteed to be accurate even if all associated quality control is acceptable.** While strict quality control conformance provides well-defined confidence in the reported results, any analytical result will always contain some error.

The user is also cautioned that the validation effort is based on the materials provided by the laboratory. Software manipulation, resulting in misleading raw data printouts, cannot be routinely detected during validation; unless otherwise stated in the report, these kinds of issues are outside the scope of this review.

### **Detailed Findings of Measurement Error Associated with the Analytical Analysis**

#### **I. Sample Integrity**

The outdoor and indoor air samples for volatiles analysis were collected over a 24-hour period from June 16 to 17, 2011, and the matching sub-slab (soil vapor) samples were collected at mid-day on June 17, 2011 for a 30-minute period. The property is located in Woburn, MA. All analyses were performed within eleven (11) days after sample collection, which is within the 30 day holding time defined in Method TO-15.

The canisters were delivered by laboratory courier to the field sampler's possession and after sampling the canisters were hand-delivered by laboratory courier to the laboratory three days after collection ended; the canisters were kept in the field engineer's office during the intervening days. A separate data package, SDG No. L1108049, was also submitted (on June 16, 2011), containing the supporting documentation (clean can certification) for the preparation and pre-sampling cleanliness check analysis of the canisters; the raw data for the vacuum and flow controller checks, as documented in the file L1108879.pdf was submitted on June 16, 2011.

The Chain of Custody (COC) and the Canister and Flow Controller Information records show that the sample canisters were collected and transported according to method specifications.

All canisters submitted to the field for use met all applicable method requirements. Based on acceptable sampling equipment conditions at receipt, sample integrity was deemed acceptable for all samples.

Field log books containing records of height of canister intake, barometric pressure, and ambient temperature at sampling locations were not submitted for review as part of this validation effort.

#### **II. GC/MS Instrument Performance Check (Tuning)**

The samples for volatiles in air analyses from SDG No. L1108879 were analyzed on a single GC/MS system identified as instrument Airlab7. The tuning of this instrument was demonstrated with analysis of 4-bromofluorobenzene (BFB); tunes were analyzed for each 24-hour period during which the samples or associated standards were analyzed. Both BFB tunes were correctly calculated, within acceptance limits, and are reported accurately on the Form 5 summaries in the data package.

#### **III. Initial Calibration (IC)**

One IC (6/25/11) was performed on instrument Airlab7 in support of the TO-15 SIM sample analyses. The IC was performed at ten concentration levels (0.02, 0.04, 0.1, 0.2, 0.5, 1.0, 2.5, 5.0, 10, and 50 part per billion by volume [ppbv]), except that the 0.02 ppbv standard was not used for calibration of naphthalene. It was noted that a standard at 20 ppbv was also analyzed and included in the data package, but was not used in the instrument calibration. Documentation of all individual IC standards was present in the data package and relative response factor (RRF) as well as percent relative standard deviation (%RSD) values were correctly calculated and accurately reported on the Form 6 summary.

Manual integrations for some target analytes, internal standards, or surrogate standards were performed in some standards and samples in this data set. The before and after ion chromatograms, the reason for the manual integration, and the analyst's initials and date were printed for each manual integration.

All average RRF values were above the 0.05 minimum criterion, and all %RSDs were below the maximum limit (30%) specified by Region I, with the exception that naphthalene exhibited a 37.3 %RSD.

An Independent Calibration Verification (ICV) sample analysis at 20 ppbv was analyzed on 6/27/11. All spiked analytes were recovered within 70 – 130 % recovery of expected values in the ICV analysis, with the exception of 1,3-butadiene, which was recovered at -41.7 % recovery.

Since the reporting limit for naphthalene is set above the lowest standard used in the calibration, no actions are necessary on the basis of the modification of the initial calibration range for this compound. On the basis of the unacceptably high %RSD value in the associated IC, results for naphthalene in all samples were qualified as estimated (J, UJ). On the basis of the unacceptably low recovery in the associated ICV analysis, results for 1,3-butadiene in all samples were qualified as estimated (UJ).

#### **IV. Continuing Calibration (CC)**

One continuing calibration (CC) standard was reported in support of the TO-15 SIM sample analyses reported in this data package; this analysis is also reported as the ICV and as the laboratory control sample analysis for this analytical window. Since this is an independent standard, this is acceptable, although redundant. Sample results were properly reported using the average RRF of the calibration curve for quantitation. Documentation of the standard analysis was present, and RRF as well as percent difference (%D) values were reported on the Form 7 summary within the data package. All RRF values were above the 0.05 minimum criterion, and all %D values were below the maximum limit (25%) specified by Region 1, with the exception of 1,3-butadiene, which exhibited a -41.7 %D.

It should be noted that a positive % D value (the CC response factor is less than the IC response factor) will result in a low bias for positive detects, and a negative % D will result in a high bias for positive detects.

Since results for 1,3-butadiene in all samples were previously qualified for this analysis on the basis of ICV criteria, no further qualifications were applied.

#### **V. Blanks**

Results for one air-matrix laboratory method blank (MB) were reported in association with the TO-15 SIM sample analyses. No target compounds were found in the MB.

One trip blank (TB), which was used as a field blank, was reported in this data package. No target compounds were found in the TB, with the exceptions of methylene chloride (9.20 ppbv), and toluene (0.094 ppbv), which are both above their respective quantitation limits (0.50 and 0.050 ppbv).

Neither a trip blank nor a field blank is required for Method TO-15.

On the basis of field contamination and professional judgment, positive results greater than the sample-specific (adjusted) quantitation limit but less than the action limit (at twice the detected concentration) for methylene chloride in samples AA-570-1-06162011, IA-70-3-06162011, IA-70-2-06162011, IA-70-1-06162011, and SS-70-1-06172011, and for toluene in SS-70-1-06172011 were qualified as less than the reported value (U).

## **VI. Surrogate Compounds**

No surrogate compounds are used in these methods.

## **VII. Internal Standards (IS)**

All IS areas and retention times (RT) were within the established QC limits for all reported sample analyses in this data package.

## **VIII. Laboratory Duplicates**

A matrix spike/matrix spike duplicate (MS/MSD) analysis is not used in this method. A laboratory duplicate analysis of a field sample (matrix duplicate) analysis is also not required but was performed per laboratory protocols. Sample IA-70-3-06162011 was reported for laboratory duplicate analysis (WG475607-5). Relative percent difference (RPD) values were reported on a Form 3 summary within the data package.

Precision in the laboratory duplicate analyses (6.8 – 11.5 %RPD) was acceptable (less than 30 % RPD, for all analytes greater than five times the reporting limit) on the basis of professional judgment.

## **IX. Field Duplicates**

One field duplicate pair was collected on 6/17/11 from a nearby location as part of this sample set, and reported separately in SDG No. L1108880.

Relative percent difference (RPD) values for compounds detected at greater than five times the quantitation limit in at least one member of a field duplicate pair must be less than 25 %RPD as per the QAPP. Precision in the field duplicate pair for naphthalene, the only detected analyte meeting threshold criteria, was acceptable (2.9 %RPD).

## **X. Sensitivity Check**

An MDL study for the TO-15 SIM method was analyzed by the laboratory on May 7, 2009, and the most recent verification study was performed between February 3 and 4, 2010. All target analytes in the statistical study had calculated MDLs below the method quantitation limits (QLs), and demonstrated acceptable ratios (at least 3:1) of the QL to the MDL. The QLs are also supported by the low concentration

standard (at 0.020 ppbv) in the initial calibration.

Project objectives required a low reporting limit (RL) for naphthalene, and in order to achieve project objectives for detection limits, the analytes 1,2-dibromoethane (EDB), bromodichloromethane, and naphthalene were evaluated by the laboratory down to one-half the RL; concentrations between one-half the RL and the RL were reported with a "J" qualifier to indicate that this was an estimated concentration on the Form 1 summaries; results below the QL were only detected for naphthalene in this sample set.

On the basis of acceptable sensitivity and accuracy, as demonstrated by the MDL study and supported by the initial calibration, all results for the TO-15 SIM method (detects and non-detects) not qualified for other reasons are deemed acceptable as reported.

#### **XI. Performance Evaluation Samples (PES)/Accuracy Check**

One zero blind PE samples (commonly known as a laboratory control sample, LCS) was prepared and analyzed by the laboratory in support of the TO-15 SIM sample analyses; this analysis was also reported as the ICV and as the CC standard analysis for this data set. All target analytes were spiked into the QC samples at 20 ppbv. Percent recoveries (%R) were correctly calculated for the spiked compounds, accurately reported on the Form 3 summary in the data package, and were within the laboratory established QC limits (70 - 130 %R) for all target analytes, with the exception (previously noted) of 1,3-butadiene, which was recovered at -41.7 %. No spiked duplicate analyses were performed for either method, so laboratory precision was not evaluated using spiked analyses.

No external single-blind PES sample for either method was required or submitted with the samples in this data set.

Since all samples in this data set were previously qualified for the unacceptably low recovery of 1,3-butadiene in this analysis (as an ICV), no further qualifications were applied.

#### **XII. Target Compound Identification**

Reported target compounds were correctly identified for all samples in this data set.

#### **XIII. Compound Quantitation and Reported Quantitation Limits**

Target compound quantitation and practical quantitation limits (PQLs) were accurately reported on the Form 1 summaries. Results below the RL are not reported by the laboratory for this method. However, at the client's request, positive results for naphthalene, bromodichloromethane, and 1,2-dibromoethane (EDB) were evaluated down to one-half the RL, and reported with a "J" qualifier by the laboratory on the Form 1s.

One compound was reported with reporting limits slightly higher than specified in the QAPP. Total xylenes were reported with a quantitation limit of 0.261  $\mu\text{g}/\text{m}^3$ . No qualifications were deemed necessary on the basis of the RL slightly above that specified in the QAPP for total xylenes, since this concentration is still well below the risk screening level.



The laboratory appropriately applied "J" qualifiers to the CLP-like sample Form 1s when the concentration of an analyte was less than the sample-specific QL for the analytes naphthalene, 1,2-dibromoethane, and bromodichloromethane in the TO-15 SIM analysis. The validator did not remove these qualifiers (results below the QL were only detected for naphthalene in this sample set).

The values that the validator has judged to be acceptable are presented on the electronic deliverable generated from the project database (Attachment A). Qualifiers applied by the validator during the validation effort have been listed on the electronic spreadsheet in an additional column labeled "Validator\_Qualifier". The column labeled "Qualifier" contains both qualifiers applied by the laboratory and those applied by the validator; all qualifiers in this column have been accepted or changed during the validation effort. The column labeled "PreValidationFlag", which is generated by the database utility, also indicates which qualifiers were changed by the validator. Sample-specific quantitation limits may be found on the Form 1 for each sample or in the electronic deliverable (Attachment A, column "ReportingLimit").

The Form 1s submitted in the data package present results in units of  $\mu\text{g}/\text{m}^3$  as well as in ppbv. Results are also presented almost entirely in units of  $\mu\text{g}/\text{m}^3$  in the electronic data deliverable (EDD). Both the forms and the EDD were examined during the data validation process.

All positive results are listed on the electronic data deliverable, whether or not the value or qualifier was changed as a result of the validation. All non-detected results are listed on the electronic data deliverable with a Qualifier of "U" or "UJ"; these are also found as less-than (<) values in the "TextResult" column. If the reported result value was changed during the validation effort from a positive result to a value representing a concentration not detected at or below, the value representing the new reporting limit is reported as the Result with a Validator Qualifier of "U" or "UJ" and a "<" sign in the "TextResult" column.

#### **XIV. Tentatively Identified Compounds (TICs)**

Evaluation of unidentified, non-target analyte peaks was not requested or performed for these samples.

#### **XV. System Performance**

The analytical system appears to have been working acceptably, based on instrument printouts and spectral quality.

#### **XVI. Overall Evaluation of Data**

Findings of the validation effort resulted in the following qualifications:

- On the basis of the unacceptably high %RSD value in the associated IC, results for naphthalene in all samples were qualified as estimated (J, UJ).
- On the basis of the unacceptably low recovery in the associated ICV analysis, results for 1,3-

butadiene in all samples were qualified as estimated (UJ).

- On the basis of field contamination and professional judgment, positive results greater than the sample-specific (adjusted) quantitation limit but less than the action limit (at twice the detected concentration) for methylene chloride in samples AA-570-1-06162011, IA-70-3-06162011, IA-70-2-06162011, IA-70-1-06162011, and SS-70-1-06172011, and for toluene in SS-70-1-06172011 were qualified as less than the reported value (U).
- The laboratory appropriately applied “J” qualifiers to the CLP-like sample Form 1s when the concentration of an analyte was less than the sample-specific QL for the analytes naphthalene, 1,2-dibromoethane, and bromodichloromethane in the TO-15 SIM analysis. The validator did not remove these qualifiers.

## **XVII. Documentation**

The required records for canister cleanliness were submitted as a separate data package, SDG No. L1108049, and all required records were properly included with this data package. Canister cleanliness and auxiliary equipment status was acceptable upon release from the laboratory, and appropriate checks and actions were performed as required upon sample and equipment receipt.

The chain of custody (COC) records were present and accurately completed for all reported samples.

Data presentation was acceptable, with the following observation:

- One compound was reported with reporting limits slightly higher than specified in the QAPP. Total xylenes were reported with a quantitation limit of 0.261 ug/m<sup>3</sup>.

This validation report should be considered part of the data package for all future distributions of the TO-15 SIM (volatiles in air) analysis data for SDG No. L1108879.

**ATTACHMENT A**

**ELECTRONIC DELIVERABLE (EDD)**

**SDG No. L1108879**

**Selected Volatiles in Air Samples  
(submitted electronically)**



## **Appendix D**

Laboratory Analytical Data Package



## ANALYTICAL REPORT

Lab Number:	L1108879
Client:	Arcadis G&M, Inc. 482 Congress Street Suite 501 Portland, ME 04101
ATTN:	Nadine Weinberg
Phone:	(207) 828-0046
Project Name:	UNIFIRST WELLS G&H
Project Number:	MA000989.0002.00003
Report Date:	08/05/11

The original project report/data package is held by Alpha Analytical. This report/data package is paginated and should be reproduced only in its entirety. Alpha Analytical holds no responsibility for results and/or data that are not consistent with the original.

Certifications & Approvals: MA (M-MA030), NY (11627), CT (PH-0141), NH (2206), NJ (MA015), RI (LAO00299), ME (MA0030), PA (Registration #68-02089), LA NELAC (03090), FL NELAC (E87814), US Army Corps of Engineers.

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320 Forbes Boulevard, Mansfield, MA 02048-1806  
508-822-9300 (Fax) 508-822-3288 800-624-9220 - [www.alphalab.com](http://www.alphalab.com)



**Project Name:** UNIFIRST WELLS G&H  
**Project Number:** MA000989.0002.00003

**Lab Number:** L1108879  
**Report Date:** 08/05/11

<b>Alpha Sample ID</b>	<b>Client ID</b>	<b>Sample Location</b>	<b>Collection Date/Time</b>
L1108879-01	AA-57O-1-06162011	WOBURN, MA	06/17/11 09:52
L1108879-02	IA-7O-3-06162011	WOBURN, MA	06/17/11 09:54
L1108879-03	IA-7O-2-06162011	WOBURN, MA	06/17/11 09:57
L1108879-04	IA-7O-1-06162011	WOBURN, MA	06/17/11 09:58
L1108879-05	SS-7O-1-06172011	WOBURN, MA	06/17/11 11:19
L1108879-06	SS-7O-2-06172011	WOBURN, MA	06/17/11 11:54
L1108879-07	TB06172011	WOBURN, MA	06/17/11 00:00

**Project Name:** UNIFIRST WELLS G&H  
**Project Number:** MA000989.0002.00003

**Lab Number:** L1108879  
**Report Date:** 08/05/11

### Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet all of the requirements of NELAC, for all NELAC accredited parameters. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively. When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

Please see the associated ADEx data file for a comparison of laboratory reporting limits that were achieved with the regulatory Numerical Standards requested on the Chain of Custody.

For additional information, please contact Client Services at 800-624-9220.

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### Report Submission

This report replaces the report issued on July 1, 2011. The client sample identifications for L1108879-01 through L1108879-06 have been amended.

This report replaces the report issued earlier today. The Chain of Custody was missing.

The canister certification results are provided as an addendum.

### Volatile Organics in Air (SIM)

1,2-Dibromoethane, Bromodichloromethane and Naphthalene were evaluated to 1/2 the RL and are J qualified if the concentration is below the quantitation limit (RDL), but greater than or equal to 1/2 the RDL. Values are estimated.

**Project Name:** UNIFIRST WELLS G&H  
**Project Number:** MA000989.0002.00003


**Lab Number:** L1108879  
**Report Date:** 08/05/11

**Case Narrative (continued)**

The WG475607-3 LCS recovery for 1,3-Butadiene (142%) is outside the 70%-130% acceptance limit. The LCS was within overall method allowances, therefore the analysis proceeded.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature:



Kathleen O'Brien

Title: Technical Director/Representative

Date: 08/05/11



**AIR**

**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108879**Project Number:** MA000989.0002.00003**Report Date:** 08/05/11**SAMPLE RESULTS**

**Lab ID:** L1108879-01  
**Client ID:** AA-57O-1-06162011  
**Sample Location:** WOBURN, MA  
**Matrix:** Air  
**Analytical Method:** 48,TO-15-SIM  
**Analytical Date:** 06/27/11 21:42  
**Analyst:** AR

**Date Collected:** 06/17/11 09:52  
**Date Received:** 06/17/11  
**Field Prep:** Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
1,1,1-Trichloroethane	ND	0.020	0.020	ND	0.109	0.109		1
1,1,2-Trichloroethane	ND	0.020	0.020	ND	0.109	0.109		1
1,1-Dichloroethane	ND	0.020	0.020	ND	0.081	0.081		1
1,1-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
1,2,4-Trimethylbenzene	0.046	0.020	0.020	0.226	0.098	0.098		1
1,2-Dibromoethane	ND	0.020	0.010	ND	0.154	0.077		1
1,2-Dichloroethane	ND	0.020	0.020	ND	0.081	0.081		1
1,2-Dichloropropane	ND	0.020	0.020	ND	0.092	0.092		1
1,3-Butadiene	ND	0.020	0.020	ND	0.044	0.044		1
1,3-Dichlorobenzene	ND	0.020	0.020	ND	0.120	0.120		1
1,4-Dichlorobenzene	ND	0.020	0.020	ND	0.120	0.120		1
Benzene	0.078	0.070	0.070	0.249	0.224	0.224		1
Bromodichloromethane	ND	0.020	0.010	ND	0.134	0.067		1
Bromoform	ND	0.020	0.020	ND	0.207	0.207		1
Carbon tetrachloride	0.075	0.020	0.020	0.472	0.126	0.126		1
Chlorobenzene	ND	0.020	0.020	ND	0.092	0.092		1
Chloroform	0.022	0.020	0.020	0.107	0.098	0.098		1
cis-1,2-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
Ethylbenzene	0.030	0.020	0.020	0.130	0.087	0.087		1
Methylene chloride	0.794	0.500	0.500	2.76	1.74	1.74		1
Methyl tert butyl ether	ND	0.020	0.020	ND	0.072	0.072		1
Naphthalene	0.058	0.050	0.025	0.304	0.262	0.131		1
Xylenes, Total	0.113	0.060	0.060	0.491	0.261	0.261		1



**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108879**Project Number:** MA000989.0002.00003**Report Date:** 08/05/11**SAMPLE RESULTS**

Lab ID: L1108879-01

Date Collected: 06/17/11 09:52

Client ID: AA-57O-1-06162011

Date Received: 06/17/11

Sample Location: WOBURN, MA

Field Prep: Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
Tetrachloroethene	ND	0.020	0.020	ND	0.136	0.136		1
Toluene	0.336	0.050	0.050	1.27	0.188	0.188		1
trans-1,2-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
trans-1,3-Dichloropropene	ND	0.020	0.020	ND	0.091	0.091		1
Trichloroethene	ND	0.020	0.020	ND	0.107	0.107		1
Vinyl chloride	ND	0.020	0.020	ND	0.051	0.051		1
Isopropylbenzene	ND	0.500	0.500	ND	2.46	2.46		1

Internal Standard	% Recovery	Qualifier	Acceptance Criteria
1,4-difluorobenzene	74		60-140
bromochloromethane	96		60-140
chlorobenzene-d5	83		60-140



**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108879**Project Number:** MA000989.0002.00003**Report Date:** 08/05/11**SAMPLE RESULTS**

Lab ID: L1108879-02  
 Client ID: IA-7O-3-06162011  
 Sample Location: WOBURN, MA  
 Matrix: Air  
 Analytical Method: 48,TO-15-SIM  
 Analytical Date: 06/27/11 22:16  
 Analyst: AR

Date Collected: 06/17/11 09:54  
 Date Received: 06/17/11  
 Field Prep: Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
1,1,1-Trichloroethane	ND	0.020	0.020	ND	0.109	0.109		1
1,1,2-Trichloroethane	ND	0.020	0.020	ND	0.109	0.109		1
1,1-Dichloroethane	ND	0.020	0.020	ND	0.081	0.081		1
1,1-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
1,2,4-Trimethylbenzene	0.036	0.020	0.020	0.177	0.098	0.098		1
1,2-Dibromoethane	ND	0.020	0.010	ND	0.154	0.077		1
1,2-Dichloroethane	0.114	0.020	0.020	0.461	0.081	0.081		1
1,2-Dichloropropane	ND	0.020	0.020	ND	0.092	0.092		1
1,3-Butadiene	ND	0.020	0.020	ND	0.044	0.044		1
1,3-Dichlorobenzene	ND	0.020	0.020	ND	0.120	0.120		1
1,4-Dichlorobenzene	ND	0.020	0.020	ND	0.120	0.120		1
Benzene	0.087	0.070	0.070	0.278	0.224	0.224		1
Bromodichloromethane	ND	0.020	0.010	ND	0.134	0.067		1
Bromoform	ND	0.020	0.020	ND	0.207	0.207		1
Carbon tetrachloride	0.073	0.020	0.020	0.459	0.126	0.126		1
Chlorobenzene	ND	0.020	0.020	ND	0.092	0.092		1
Chloroform	0.028	0.020	0.020	0.137	0.098	0.098		1
cis-1,2-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
Ethylbenzene	0.045	0.020	0.020	0.195	0.087	0.087		1
Methylene chloride	0.964	0.500	0.500	3.35	1.74	1.74		1
Methyl tert butyl ether	ND	0.020	0.020	ND	0.072	0.072		1
Naphthalene	0.026	0.050	0.025	0.136	0.262	0.131	J	1
Xylenes, Total	0.142	0.060	0.060	0.617	0.261	0.261		1



**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108879**Project Number:** MA000989.0002.00003**Report Date:** 08/05/11**SAMPLE RESULTS**

Lab ID: L1108879-02

Date Collected: 06/17/11 09:54

Client ID: IA-7O-3-06162011

Date Received: 06/17/11

Sample Location: WOBURN, MA

Field Prep: Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
Tetrachloroethene	ND	0.020	0.020	ND	0.136	0.136		1
Toluene	0.320	0.050	0.050	1.20	0.188	0.188		1
trans-1,2-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
trans-1,3-Dichloropropene	ND	0.020	0.020	ND	0.091	0.091		1
Trichloroethene	ND	0.020	0.020	ND	0.107	0.107		1
Vinyl chloride	ND	0.020	0.020	ND	0.051	0.051		1
Isopropylbenzene	ND	0.500	0.500	ND	2.46	2.46		1

Internal Standard	% Recovery	Qualifier	Acceptance Criteria
1,4-difluorobenzene	87		60-140
bromochloromethane	111		60-140
chlorobenzene-d5	108		60-140



**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108879**Project Number:** MA000989.0002.00003**Report Date:** 08/05/11**SAMPLE RESULTS**

Lab ID: L1108879-03  
 Client ID: IA-7O-2-06162011  
 Sample Location: WOBURN, MA  
 Matrix: Air  
 Analytical Method: 48,TO-15-SIM  
 Analytical Date: 06/27/11 23:25  
 Analyst: AR

Date Collected: 06/17/11 09:57  
 Date Received: 06/17/11  
 Field Prep: Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
1,1,1-Trichloroethane	ND	0.020	0.020	ND	0.109	0.109		1
1,1,2-Trichloroethane	ND	0.020	0.020	ND	0.109	0.109		1
1,1-Dichloroethane	ND	0.020	0.020	ND	0.081	0.081		1
1,1-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
1,2,4-Trimethylbenzene	0.052	0.020	0.020	0.256	0.098	0.098		1
1,2-Dibromoethane	ND	0.020	0.010	ND	0.154	0.077		1
1,2-Dichloroethane	0.040	0.020	0.020	0.162	0.081	0.081		1
1,2-Dichloropropane	ND	0.020	0.020	ND	0.092	0.092		1
1,3-Butadiene	ND	0.020	0.020	ND	0.044	0.044		1
1,3-Dichlorobenzene	ND	0.020	0.020	ND	0.120	0.120		1
1,4-Dichlorobenzene	ND	0.020	0.020	ND	0.120	0.120		1
Benzene	0.108	0.070	0.070	0.345	0.224	0.224		1
Bromodichloromethane	ND	0.020	0.010	ND	0.134	0.067		1
Bromoform	ND	0.020	0.020	ND	0.207	0.207		1
Carbon tetrachloride	0.074	0.020	0.020	0.465	0.126	0.126		1
Chlorobenzene	ND	0.020	0.020	ND	0.092	0.092		1
Chloroform	0.041	0.020	0.020	0.200	0.098	0.098		1
cis-1,2-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
Ethylbenzene	0.105	0.020	0.020	0.456	0.087	0.087		1
Methylene chloride	0.511	0.500	0.500	1.78	1.74	1.74		1
Methyl tert butyl ether	ND	0.020	0.020	ND	0.072	0.072		1
Naphthalene	0.036	0.050	0.025	0.189	0.262	0.131	J	1
Xylenes, Total	0.218	0.060	0.060	0.947	0.261	0.261		1



**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108879**Project Number:** MA000989.0002.00003**Report Date:** 08/05/11**SAMPLE RESULTS**

Lab ID: L1108879-03

Date Collected: 06/17/11 09:57

Client ID: IA-7O-2-06162011

Date Received: 06/17/11

Sample Location: WOBURN, MA

Field Prep: Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
Tetrachloroethene	ND	0.020	0.020	ND	0.136	0.136		1
Toluene	0.495	0.050	0.050	1.86	0.188	0.188		1
trans-1,2-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
trans-1,3-Dichloropropene	ND	0.020	0.020	ND	0.091	0.091		1
Trichloroethene	ND	0.020	0.020	ND	0.107	0.107		1
Vinyl chloride	ND	0.020	0.020	ND	0.051	0.051		1
Isopropylbenzene	ND	0.500	0.500	ND	2.46	2.46		1

Internal Standard	% Recovery	Qualifier	Acceptance Criteria
1,4-difluorobenzene	89		60-140
bromochloromethane	109		60-140
chlorobenzene-d5	111		60-140



**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108879**Project Number:** MA000989.0002.00003**Report Date:** 08/05/11**SAMPLE RESULTS**

**Lab ID:** L1108879-04  
**Client ID:** IA-7O-1-06162011  
**Sample Location:** WOBURN, MA  
**Matrix:** Air  
**Analytical Method:** 48,TO-15-SIM  
**Analytical Date:** 06/27/11 23:59  
**Analyst:** AR

**Date Collected:** 06/17/11 09:58  
**Date Received:** 06/17/11  
**Field Prep:** Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
1,1,1-Trichloroethane	ND	0.020	0.020	ND	0.109	0.109		1
1,1,2-Trichloroethane	ND	0.020	0.020	ND	0.109	0.109		1
1,1-Dichloroethane	ND	0.020	0.020	ND	0.081	0.081		1
1,1-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
1,2,4-Trimethylbenzene	0.052	0.020	0.020	0.256	0.098	0.098		1
1,2-Dibromoethane	ND	0.020	0.010	ND	0.154	0.077		1
1,2-Dichloroethane	0.050	0.020	0.020	0.202	0.081	0.081		1
1,2-Dichloropropane	ND	0.020	0.020	ND	0.092	0.092		1
1,3-Butadiene	ND	0.020	0.020	ND	0.044	0.044		1
1,3-Dichlorobenzene	ND	0.020	0.020	ND	0.120	0.120		1
1,4-Dichlorobenzene	ND	0.020	0.020	ND	0.120	0.120		1
Benzene	0.099	0.070	0.070	0.316	0.224	0.224		1
Bromodichloromethane	ND	0.020	0.010	ND	0.134	0.067		1
Bromoform	ND	0.020	0.020	ND	0.207	0.207		1
Carbon tetrachloride	0.067	0.020	0.020	0.421	0.126	0.126		1
Chlorobenzene	ND	0.020	0.020	ND	0.092	0.092		1
Chloroform	0.048	0.020	0.020	0.234	0.098	0.098		1
cis-1,2-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
Ethylbenzene	0.110	0.020	0.020	0.478	0.087	0.087		1
Methylene chloride	0.624	0.500	0.500	2.17	1.74	1.74		1
Methyl tert butyl ether	ND	0.020	0.020	ND	0.072	0.072		1
Naphthalene	0.031	0.050	0.025	0.162	0.262	0.131	J	1
Xylenes, Total	0.221	0.060	0.060	0.960	0.261	0.261		1





**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108879**Project Number:** MA000989.0002.00003**Report Date:** 08/05/11**SAMPLE RESULTS**

Lab ID: L1108879-04

Date Collected: 06/17/11 09:58

Client ID: IA-7O-1-06162011

Date Received: 06/17/11

Sample Location: WOBURN, MA

Field Prep: Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
Tetrachloroethene	ND	0.020	0.020	ND	0.136	0.136		1
Toluene	0.617	0.050	0.050	2.32	0.188	0.188		1
trans-1,2-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
trans-1,3-Dichloropropene	ND	0.020	0.020	ND	0.091	0.091		1
Trichloroethene	ND	0.020	0.020	ND	0.107	0.107		1
Vinyl chloride	ND	0.020	0.020	ND	0.051	0.051		1
Isopropylbenzene	ND	0.500	0.500	ND	2.46	2.46		1

Internal Standard	% Recovery	Qualifier	Acceptance Criteria
1,4-difluorobenzene	99		60-140
bromochloromethane	99		60-140
chlorobenzene-d5	113		60-140

**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108879**Project Number:** MA000989.0002.00003**Report Date:** 08/05/11**SAMPLE RESULTS**

**Lab ID:** L1108879-05  
**Client ID:** SS-70-1-06172011  
**Sample Location:** WOBURN, MA  
**Matrix:** Soil\_Vapor  
**Analytical Method:** 48,TO-15-SIM  
**Analytical Date:** 06/28/11 01:42  
**Analyst:** AR

**Date Collected:** 06/17/11 11:19  
**Date Received:** 06/17/11  
**Field Prep:** Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
1,1,1-Trichloroethane	0.050	0.020	0.020	0.273	0.109	0.109		1
1,1,2-Trichloroethane	ND	0.020	0.020	ND	0.109	0.109		1
1,1-Dichloroethane	ND	0.020	0.020	ND	0.081	0.081		1
1,1-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
1,2,4-Trimethylbenzene	0.045	0.020	0.020	0.221	0.098	0.098		1
1,2-Dibromoethane	ND	0.020	0.010	ND	0.154	0.077		1
1,2-Dichloroethane	ND	0.020	0.020	ND	0.081	0.081		1
1,2-Dichloropropane	ND	0.020	0.020	ND	0.092	0.092		1
1,3-Butadiene	ND	0.020	0.020	ND	0.044	0.044		1
1,3-Dichlorobenzene	ND	0.020	0.020	ND	0.120	0.120		1
1,4-Dichlorobenzene	ND	0.020	0.020	ND	0.120	0.120		1
Benzene	ND	0.070	0.070	ND	0.224	0.224		1
Bromodichloromethane	ND	0.020	0.010	ND	0.134	0.067		1
Bromoform	ND	0.020	0.020	ND	0.207	0.207		1
Carbon tetrachloride	0.023	0.020	0.020	0.145	0.126	0.126		1
Chlorobenzene	ND	0.020	0.020	ND	0.092	0.092		1
Chloroform	0.045	0.020	0.020	0.220	0.098	0.098		1
cis-1,2-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
Ethylbenzene	ND	0.020	0.020	ND	0.087	0.087		1
Methylene chloride	0.871	0.500	0.500	3.02	1.74	1.74		1
Methyl tert butyl ether	ND	0.020	0.020	ND	0.072	0.072		1
Naphthalene	ND	0.050	0.025	ND	0.262	0.131		1
Xylenes, Total	0.089	0.060	0.060	0.386	0.261	0.261		1



**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108879**Project Number:** MA000989.0002.00003**Report Date:** 08/05/11**SAMPLE RESULTS**

Lab ID: L1108879-05

Date Collected: 06/17/11 11:19

Client ID: SS-7O-1-06172011

Date Received: 06/17/11

Sample Location: WOBURN, MA

Field Prep: Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
Tetrachloroethene	10.9	0.020	0.020	73.9	0.136	0.136		1
Toluene	0.182	0.050	0.050	0.686	0.188	0.188		1
trans-1,2-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
trans-1,3-Dichloropropene	ND	0.020	0.020	ND	0.091	0.091		1
Trichloroethene	ND	0.020	0.020	ND	0.107	0.107		1
Vinyl chloride	ND	0.020	0.020	ND	0.051	0.051		1
Isopropylbenzene	ND	0.500	0.500	ND	2.46	2.46		1

Internal Standard	% Recovery	Qualifier	Acceptance Criteria
1,4-difluorobenzene	92		60-140
bromochloromethane	93		60-140
chlorobenzene-d5	106		60-140



**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108879**Project Number:** MA000989.0002.00003**Report Date:** 08/05/11**SAMPLE RESULTS**

**Lab ID:** L1108879-06  
**Client ID:** SS-70-2-06172011  
**Sample Location:** WOBURN, MA  
**Matrix:** Soil\_Vapor  
**Analytical Method:** 48,TO-15-SIM  
**Analytical Date:** 06/28/11 02:17  
**Analyst:** AR

**Date Collected:** 06/17/11 11:54  
**Date Received:** 06/17/11  
**Field Prep:** Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
1,1,1-Trichloroethane	0.028	0.020	0.020	0.153	0.109	0.109		1
1,1,2-Trichloroethane	ND	0.020	0.020	ND	0.109	0.109		1
1,1-Dichloroethane	ND	0.020	0.020	ND	0.081	0.081		1
1,1-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
1,2,4-Trimethylbenzene	ND	0.020	0.020	ND	0.098	0.098		1
1,2-Dibromoethane	ND	0.020	0.010	ND	0.154	0.077		1
1,2-Dichloroethane	ND	0.020	0.020	ND	0.081	0.081		1
1,2-Dichloropropane	ND	0.020	0.020	ND	0.092	0.092		1
1,3-Butadiene	ND	0.020	0.020	ND	0.044	0.044		1
1,3-Dichlorobenzene	ND	0.020	0.020	ND	0.120	0.120		1
1,4-Dichlorobenzene	ND	0.020	0.020	ND	0.120	0.120		1
Benzene	ND	0.070	0.070	ND	0.224	0.224		1
Bromodichloromethane	ND	0.020	0.010	ND	0.134	0.067		1
Bromoform	ND	0.020	0.020	ND	0.207	0.207		1
Carbon tetrachloride	ND	0.020	0.020	ND	0.126	0.126		1
Chlorobenzene	ND	0.020	0.020	ND	0.092	0.092		1
Chloroform	0.034	0.020	0.020	0.166	0.098	0.098		1
cis-1,2-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
Ethylbenzene	ND	0.020	0.020	ND	0.087	0.087		1
Methylene chloride	ND	0.500	0.500	ND	1.74	1.74		1
Methyl tert butyl ether	ND	0.020	0.020	ND	0.072	0.072		1
Naphthalene	ND	0.050	0.025	ND	0.262	0.131		1
Xylenes, Total	ND	0.060	0.060	ND	0.261	0.261		1



**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108879**Project Number:** MA000989.0002.00003**Report Date:** 08/05/11**SAMPLE RESULTS**

Lab ID: L1108879-06

Date Collected: 06/17/11 11:54

Client ID: SS-7O-2-06172011

Date Received: 06/17/11

Sample Location: WOBURN, MA

Field Prep: Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
Tetrachloroethene	21.4	0.020	0.020	145	0.136	0.136		1
Toluene	ND	0.050	0.050	ND	0.188	0.188		1
trans-1,2-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
trans-1,3-Dichloropropene	ND	0.020	0.020	ND	0.091	0.091		1
Trichloroethene	ND	0.020	0.020	ND	0.107	0.107		1
Vinyl chloride	ND	0.020	0.020	ND	0.051	0.051		1
Isopropylbenzene	ND	0.500	0.500	ND	2.46	2.46		1

Internal Standard	% Recovery	Qualifier	Acceptance Criteria
1,4-difluorobenzene	95		60-140
bromochloromethane	97		60-140
chlorobenzene-d5	109		60-140



**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108879**Project Number:** MA000989.0002.00003**Report Date:** 08/05/11**SAMPLE RESULTS**

**Lab ID:** L1108879-07  
**Client ID:** TB06172011  
**Sample Location:** WOBURN, MA  
**Matrix:** Air  
**Analytical Method:** 48,TO-15-SIM  
**Analytical Date:** 06/27/11 21:08  
**Analyst:** AR

**Date Collected:** 06/17/11 00:00  
**Date Received:** 06/17/11  
**Field Prep:** Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
1,1,1-Trichloroethane	ND	0.020	0.020	ND	0.109	0.109		1
1,1,2-Trichloroethane	ND	0.020	0.020	ND	0.109	0.109		1
1,1-Dichloroethane	ND	0.020	0.020	ND	0.081	0.081		1
1,1-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
1,2,4-Trimethylbenzene	ND	0.020	0.020	ND	0.098	0.098		1
1,2-Dibromoethane	ND	0.020	0.010	ND	0.154	0.077		1
1,2-Dichloroethane	ND	0.020	0.020	ND	0.081	0.081		1
1,2-Dichloropropane	ND	0.020	0.020	ND	0.092	0.092		1
1,3-Butadiene	ND	0.020	0.020	ND	0.044	0.044		1
1,3-Dichlorobenzene	ND	0.020	0.020	ND	0.120	0.120		1
1,4-Dichlorobenzene	ND	0.020	0.020	ND	0.120	0.120		1
Benzene	ND	0.070	0.070	ND	0.224	0.224		1
Bromodichloromethane	ND	0.020	0.010	ND	0.134	0.067		1
Bromoform	ND	0.020	0.020	ND	0.207	0.207		1
Carbon tetrachloride	ND	0.020	0.020	ND	0.126	0.126		1
Chlorobenzene	ND	0.020	0.020	ND	0.092	0.092		1
Chloroform	ND	0.020	0.020	ND	0.098	0.098		1
cis-1,2-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
Ethylbenzene	ND	0.020	0.020	ND	0.087	0.087		1
Methylene chloride	9.20	0.500	0.500	32.0	1.74	1.74		1
Methyl tert butyl ether	ND	0.020	0.020	ND	0.072	0.072		1
Naphthalene	ND	0.050	0.025	ND	0.262	0.131		1
Xylenes, Total	ND	0.060	0.060	ND	0.261	0.261		1



**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108879**Project Number:** MA000989.0002.00003**Report Date:** 08/05/11**SAMPLE RESULTS**

Lab ID: L1108879-07  
 Client ID: TB06172011  
 Sample Location: WOBURN, MA

Date Collected: 06/17/11 00:00  
 Date Received: 06/17/11  
 Field Prep: Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
Tetrachloroethene	ND	0.020	0.020	ND	0.136	0.136		1
Toluene	0.094	0.050	0.050	0.354	0.188	0.188		1
trans-1,2-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
trans-1,3-Dichloropropene	ND	0.020	0.020	ND	0.091	0.091		1
Trichloroethene	ND	0.020	0.020	ND	0.107	0.107		1
Vinyl chloride	ND	0.020	0.020	ND	0.051	0.051		1
Isopropylbenzene	ND	0.500	0.500	ND	2.46	2.46		1

Internal Standard	% Recovery	Qualifier	Acceptance Criteria
1,4-difluorobenzene	76		60-140
bromochloromethane	85		60-140
chlorobenzene-d5	76		60-140

Project Name: UNIFIRST WELLS G&amp;H

Lab Number: L1108879

Project Number: MA000989.0002.00003

Report Date: 08/05/11

### Method Blank Analysis Batch Quality Control

Analytical Method: 48,TO-15-SIM

Analytical Date: 06/27/11 19:46

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab for sample(s): 01-07 Batch: WG475607-4								
1,1,1-Trichloroethane	ND	0.020	0.020	ND	0.109	0.109		1
1,1,2-Trichloroethane	ND	0.020	0.020	ND	0.109	0.109		1
1,1-Dichloroethane	ND	0.020	0.020	ND	0.081	0.081		1
1,1-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
1,2,4-Trimethylbenzene	ND	0.020	0.020	ND	0.098	0.098		1
1,2-Dibromoethane	ND	0.020	0.010	ND	0.154	0.077		1
1,2-Dichloroethane	ND	0.020	0.020	ND	0.081	0.081		1
1,2-Dichloropropane	ND	0.020	0.020	ND	0.092	0.092		1
1,3-Butadiene	ND	0.020	0.020	ND	0.044	0.044		1
1,3-Dichlorobenzene	ND	0.020	0.020	ND	0.120	0.120		1
1,4-Dichlorobenzene	ND	0.020	0.020	ND	0.120	0.120		1
Benzene	ND	0.070	0.070	ND	0.224	0.224		1
Bromodichloromethane	ND	0.020	0.010	ND	0.134	0.067		1
Bromoform	ND	0.020	0.020	ND	0.207	0.207		1
Carbon tetrachloride	ND	0.020	0.020	ND	0.126	0.126		1
Chlorobenzene	ND	0.020	0.020	ND	0.092	0.092		1
Chloroform	ND	0.020	0.020	ND	0.098	0.098		1
cis-1,2-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
Ethylbenzene	ND	0.020	0.020	ND	0.087	0.087		1
Methylene chloride	ND	0.500	0.500	ND	1.74	1.74		1
Methyl tert butyl ether	ND	0.020	0.020	ND	0.072	0.072		1
Naphthalene	ND	0.050	0.025	ND	0.262	0.131		1
Xylenes, Total	ND	0.060	0.060	ND	0.261	0.261		1
Tetrachloroethene	ND	0.020	0.020	ND	0.136	0.136		1
Toluene	ND	0.050	0.050	ND	0.188	0.188		1





**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108879**Project Number:** MA000989.0002.00003**Report Date:** 08/05/11

### Method Blank Analysis Batch Quality Control

Analytical Method: 48,TO-15-SIM

Analytical Date: 06/27/11 19:46

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab for sample(s): 01-07 Batch: WG475607-4								
trans-1,2-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
trans-1,3-Dichloropropene	ND	0.020	0.020	ND	0.091	0.091		1
Trichloroethene	ND	0.020	0.020	ND	0.107	0.107		1
Vinyl chloride	ND	0.020	0.020	ND	0.051	0.051		1
Isopropylbenzene	ND	0.500	0.500	ND	2.46	2.46		1

# **Lab Control Sample Analysis** Batch Quality Control

**Project Name:** UNIFIRST WELLS G&H  
**Project Number:** MA000989.0002.00003

**Lab Number:** L1108879  
**Report Date:** 08/05/11

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Volatile Organics in Air by SIM - Mansfield Lab Associated sample(s): 01-07 Batch: WG475607-3								
1,1,1-Trichloroethane	86		-		70-130	-		25
1,1,2-Trichloroethane	84		-		70-130	-		25
1,1-Dichloroethane	97		-		70-130	-		25
1,1-Dichloroethene	114		-		70-130	-		25
1,2,4-Trimethylbenzene	82		-		70-130	-		25
1,2-Dibromoethane	92		-		70-130	-		25
1,2-Dichloroethane	95		-		70-130	-		25
1,2-Dichloropropane	88		-		70-130	-		25
1,3-Butadiene	142	Q	-		70-130	-		25
1,3-Dichlorobenzene	85		-		70-130	-		25
1,4-Dichlorobenzene	82		-		70-130	-		25
Benzene	83		-		70-130	-		25
Bromodichloromethane	95		-		70-130	-		25
Bromoform	108		-		70-130	-		25
Carbon tetrachloride	97		-		70-130	-		25
Chlorobenzene	92		-		70-130	-		25
Chloroform	94		-		70-130	-		25
cis-1,2-Dichloroethene	97		-		70-130	-		25
Ethylbenzene	87		-		70-130	-		25
Methylene chloride	102		-		70-130	-		25
Methyl tert butyl ether	88		-		70-130	-		25

## Lab Control Sample Analysis

### Batch Quality Control

**Project Name:** UNIFIRST WELLS G&H  
**Project Number:** MA000989.0002.00003

**Lab Number:** L1108879  
**Report Date:** 08/05/11

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Volatile Organics in Air by SIM - Mansfield Lab Associated sample(s): 01-07 Batch: WG475607-3								
Naphthalene	79		-		70-130	-		25
p/m-Xylene	88		-		70-130	-		25
o-Xylene	88		-		70-130	-		25
Tetrachloroethene	97		-		70-130	-		25
Toluene	76		-		70-130	-		25
trans-1,2-Dichloroethene	99		-		70-130	-		25
trans-1,3-Dichloropropene	77		-		70-130	-		25
Trichloroethene	88		-		70-130	-		25
Vinyl chloride	121		-		70-130	-		25
Isopropylbenzene	82		-		70-130	-		25

# **Lab Duplicate Analysis** Batch Quality Control

**Project Name:** UNIFIRST WELLS G&H  
**Project Number:** MA000989.0002.00C

**Lab Number:** L1108879  
**Report Date:** 08/05/11

Parameter	Native Sample	Duplicate Sample	Units	RPD	Qual	RPD Limits
Volatile Organics in Air by SIM - Mansfield Lab Associated sample(s): 01-07 QC Batch ID: WG475607-5 QC Sample: L1108879-02 Client ID: IA-7O-3-06162011						
1,1,1-Trichloroethane	ND	ND	ppbV	NC		25
1,1,2-Trichloroethane	ND	ND	ppbV	NC		25
1,1-Dichloroethane	ND	ND	ppbV	NC		25
1,1-Dichloroethene	ND	ND	ppbV	NC		25
1,2,4-Trimethylbenzene	0.036	0.046	ppbV	24		25
1,2-Dibromoethane	ND	ND	ppbV	NC		25
1,2-Dichloroethane	0.114	0.122	ppbV	7		25
1,2-Dichloropropane	ND	ND	ppbV	NC		25
1,3-Butadiene	ND	ND	ppbV	NC		25
1,3-Dichlorobenzene	ND	ND	ppbV	NC		25
1,4-Dichlorobenzene	ND	ND	ppbV	NC		25
Benzene	0.087	0.086	ppbV	1		25
Bromodichloromethane	ND	ND	ppbV	NC		25
Bromoform	ND	ND	ppbV	NC		25
Carbon tetrachloride	0.073	0.073	ppbV	0		25
Chlorobenzene	ND	ND	ppbV	NC		25
Chloroform	0.028	0.028	ppbV	0		25
cis-1,2-Dichloroethene	ND	ND	ppbV	NC		25
Ethylbenzene	0.045	0.045	ppbV	0		25

**Project Name:** UNIFIRST WELLS G&H  
**Project Number:** MA000989.0002.00C

**Lab Duplicate Analysis**  
**Batch Quality Control**

**Lab Number:** L1108879  
**Report Date:** 08/05/11

Parameter	Native Sample	Duplicate Sample	Units	RPD	RPD Limits
Volatile Organics in Air by SIM - Mansfield Lab Associated sample(s): 01-07 QC Batch ID: WG475607-5 QC Sample: L1108879-02 Client ID: IA-7O-3-06162011					
Methylene chloride	0.964	0.804	ppbV	18	25
Methyl tert butyl ether	ND	ND	ppbV	NC	25
Naphthalene	0.026J	0.037J	ppbV	NC	25
Xylenes, Total	0.142	0.154	ppbV	8	25
Tetrachloroethene	ND	ND	ppbV	NC	25
Toluene	0.320	0.359	ppbV	11	25
trans-1,2-Dichloroethene	ND	ND	ppbV	NC	25
trans-1,3-Dichloropropene	ND	ND	ppbV	NC	25
Trichloroethene	ND	ND	ppbV	NC	25
Vinyl chloride	ND	ND	ppbV	NC	25
Isopropylbenzene	ND	ND	ppbV	NC	25

**Project Name:** UNIFIRST WELLS G&H

Serial\_No:08051113:31  
**Lab Number:** L1108879

**Project Number:** MA000989.0002.00003

**Report Date:** 08/05/11

### Canister and Flow Controller Information

Samplenum	Client ID	Media ID	Media Type	Cleaning Batch ID	Initial Pressure (in. Hg)	Pressure on Receipt (in. Hg)	Flow Out mL/min	Flow In mL/min	% RSD
L1108879-01	AA-57O-1-06162011	0481	#16 AMB		-	-	3.3	3.6	9
L1108879-01	AA-57O-1-06162011	995	6.0L Can	L1108049-11	-29.4	-5.4	-	-	-
L1108879-02	IA-7O-3-06162011	0129	#16 AMB		-	-	3.1	3.3	6
L1108879-02	IA-7O-3-06162011	648	6.0L Can	L1108049-03	-29.4	-7.5	-	-	-
L1108879-03	IA-7O-2-06162011	0229	#90 SV		-	-	3.2	3.6	12
L1108879-03	IA-7O-2-06162011	1619	6.0L Can	L1108049-09	-29.4	-4.6	-	-	-
L1108879-04	IA-7O-1-06162011	0131	#16 SV		-	-	3.1	3.3	6
L1108879-04	IA-7O-1-06162011	901	6.0L Can	L1108049-18	-29.4	-5.6	-	-	-
L1108879-05	SS-7O-1-06172011	0293	#90 SV		-	-	160	165	3
L1108879-05	SS-7O-1-06172011	1672	6.0L Can	L1108049-32	-29.4	-4.6	-	-	-
L1108879-06	SS-7O-2-06172011	0353	#90 SV		-	-	160	164	2
L1108879-06	SS-7O-2-06172011	1669	6.0L Can	L1108049-30	-29.4	-6.0	-	-	-
L1108879-07	TB06172011	0149	#16 AMB		-	-	3.0	3.6	18
L1108879-07	TB06172011	1691	6.0L Can	L1108049-04	-29.4	-29.4	-	-	-



## **Air Volatiles Can Certification**

**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108049**Project Number:** Not Specified**Report Date:** 08/05/11**Air Canister Certification Results**

Lab ID: L1108049-03

Date Collected: 06/08/11 00:00

Client ID: CAN 648 FC 129

Date Received: 06/08/11

Sample Location:

Field Prep: Not Specified

Matrix: Air

Analytical Method: 48,TO-15-SIM

Analytical Date: 06/08/11 20:46

Analyst: RY

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
1,1,1-Trichloroethane	ND	0.020	0.020	ND	0.109	0.109		1
1,1,2-Trichloroethane	ND	0.020	0.020	ND	0.109	0.109		1
1,1-Dichloroethane	ND	0.020	0.020	ND	0.081	0.081		1
1,1-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
1,2,4-Trimethylbenzene	ND	0.020	0.020	ND	0.098	0.098		1
1,2-Dibromoethane	ND	0.020	0.010	ND	0.154	0.077		1
1,2-Dichloroethane	ND	0.020	0.020	ND	0.081	0.081		1
1,2-Dichloropropane	ND	0.020	0.020	ND	0.092	0.092		1
1,3-Butadiene	ND	0.020	0.020	ND	0.044	0.044		1
1,3-Dichlorobenzene	ND	0.020	0.020	ND	0.120	0.120		1
1,4-Dichlorobenzene	ND	0.020	0.020	ND	0.120	0.120		1
Benzene	ND	0.070	0.070	ND	0.224	0.224		1
Bromodichloromethane	ND	0.020	0.010	ND	0.134	0.067		1
Bromoform	ND	0.020	0.020	ND	0.207	0.207		1
Carbon tetrachloride	ND	0.020	0.020	ND	0.126	0.126		1
Chlorobenzene	ND	0.020	0.020	ND	0.092	0.092		1
Chloroform	ND	0.020	0.020	ND	0.098	0.098		1
cis-1,2-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
Ethylbenzene	ND	0.020	0.020	ND	0.087	0.087		1
Methylene chloride	ND	0.500	0.500	ND	1.74	1.74		1
Methyl tert butyl ether	ND	0.020	0.020	ND	0.072	0.072		1
Naphthalene	ND	0.050	0.025	ND	0.262	0.131		1
p/m-Xylene	ND	0.040	0.040	ND	0.174	0.174		1
o-Xylene	ND	0.020	0.020	ND	0.087	0.087		1
XYLENE (TOTAL)	ND	0.060	0.060	ND	0.261	0.261		1





**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108049**Project Number:** Not Specified**Report Date:** 08/05/11**Air Canister Certification Results**

Lab ID: L1108049-03

Date Collected: 06/08/11 00:00

Client ID: CAN 648 FC 129

Date Received: 06/08/11

Sample Location:

Field Prep: Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
Tetrachloroethene	ND	0.020	0.020	ND	0.136	0.136		1
Toluene	ND	0.050	0.050	ND	0.188	0.188		1
trans-1,2-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
trans-1,3-Dichloropropene	ND	0.020	0.020	ND	0.091	0.091		1
Trichloroethene	ND	0.020	0.020	ND	0.107	0.107		1
Vinyl chloride	ND	0.020	0.020	ND	0.051	0.051		1
Isopropylbenzene	ND	0.500	0.500	ND	2.46	2.46		1

**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108049**Project Number:** Not Specified**Report Date:** 08/05/11**Air Canister Certification Results**

Lab ID: L1108049-03

Date Collected: 06/08/11 00:00

Client ID: CAN 648 FC 129

Date Received: 06/08/11

Sample Location:

Field Prep: Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								

Internal Standard	% Recovery	Qualifier	Acceptance Criteria
1,4-difluorobenzene	92		60-140
bromochloromethane	117		60-140
chlorobenzene-d5	78		60-140

**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108049**Project Number:** Not Specified**Report Date:** 08/05/11**Air Canister Certification Results**

Lab ID: L1108049-04  
 Client ID: CAN 1691 FC 149  
 Sample Location:  
 Matrix: Air  
 Analytical Method: 48,TO-15-SIM  
 Analytical Date: 06/08/11 21:23  
 Analyst: RY

Date Collected: 06/08/11 00:00  
 Date Received: 06/08/11  
 Field Prep: Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
1,1,1-Trichloroethane	ND	0.020	0.020	ND	0.109	0.109		1
1,1,2-Trichloroethane	ND	0.020	0.020	ND	0.109	0.109		1
1,1-Dichloroethane	ND	0.020	0.020	ND	0.081	0.081		1
1,1-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
1,2,4-Trimethylbenzene	ND	0.020	0.020	ND	0.098	0.098		1
1,2-Dibromoethane	ND	0.020	0.010	ND	0.154	0.077		1
1,2-Dichloroethane	ND	0.020	0.020	ND	0.081	0.081		1
1,2-Dichloropropane	ND	0.020	0.020	ND	0.092	0.092		1
1,3-Butadiene	ND	0.020	0.020	ND	0.044	0.044		1
1,3-Dichlorobenzene	ND	0.020	0.020	ND	0.120	0.120		1
1,4-Dichlorobenzene	ND	0.020	0.020	ND	0.120	0.120		1
Benzene	ND	0.070	0.070	ND	0.224	0.224		1
Bromodichloromethane	ND	0.020	0.010	ND	0.134	0.067		1
Bromoform	ND	0.020	0.020	ND	0.207	0.207		1
Carbon tetrachloride	ND	0.020	0.020	ND	0.126	0.126		1
Chlorobenzene	ND	0.020	0.020	ND	0.092	0.092		1
Chloroform	ND	0.020	0.020	ND	0.098	0.098		1
cis-1,2-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
Ethylbenzene	ND	0.020	0.020	ND	0.087	0.087		1
Methylene chloride	ND	0.500	0.500	ND	1.74	1.74		1
Methyl tert butyl ether	ND	0.020	0.020	ND	0.072	0.072		1
Naphthalene	ND	0.050	0.025	ND	0.262	0.131		1
p/m-Xylene	ND	0.040	0.040	ND	0.174	0.174		1
o-Xylene	ND	0.020	0.020	ND	0.087	0.087		1
XYLENE (TOTAL)	ND	0.060	0.060	ND	0.261	0.261		1



**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108049**Project Number:** Not Specified**Report Date:** 08/05/11**Air Canister Certification Results**

Lab ID: L1108049-04

Date Collected: 06/08/11 00:00

Client ID: CAN 1691 FC 149

Date Received: 06/08/11

Sample Location:

Field Prep: Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
Tetrachloroethene	ND	0.020	0.020	ND	0.136	0.136		1
Toluene	ND	0.050	0.050	ND	0.188	0.188		1
trans-1,2-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
trans-1,3-Dichloropropene	ND	0.020	0.020	ND	0.091	0.091		1
Trichloroethene	ND	0.020	0.020	ND	0.107	0.107		1
Vinyl chloride	ND	0.020	0.020	ND	0.051	0.051		1
Isopropylbenzene	ND	0.500	0.500	ND	2.46	2.46		1

**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108049**Project Number:** Not Specified**Report Date:** 08/05/11**Air Canister Certification Results**

Lab ID: L1108049-04

Date Collected: 06/08/11 00:00

Client ID: CAN 1691 FC 149

Date Received: 06/08/11

Sample Location:

Field Prep: Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								

Internal Standard	% Recovery	Qualifier	Acceptance Criteria
1,4-difluorobenzene	80		60-140
bromochloromethane	110		60-140
chlorobenzene-d5	73		60-140

**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108049**Project Number:** Not Specified**Report Date:** 08/05/11**Air Canister Certification Results**

Lab ID: L1108049-09  
 Client ID: CAN 1619 FC 229  
 Sample Location:  
 Matrix: Air  
 Analytical Method: 48,TO-15-SIM  
 Analytical Date: 06/09/11 00:25  
 Analyst: RY

Date Collected: 06/08/11 00:00  
 Date Received: 06/08/11  
 Field Prep: Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
1,1,1-Trichloroethane	ND	0.020	0.020	ND	0.109	0.109		1
1,1,2-Trichloroethane	ND	0.020	0.020	ND	0.109	0.109		1
1,1-Dichloroethane	ND	0.020	0.020	ND	0.081	0.081		1
1,1-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
1,2,4-Trimethylbenzene	ND	0.020	0.020	ND	0.098	0.098		1
1,2-Dibromoethane	ND	0.020	0.010	ND	0.154	0.077		1
1,2-Dichloroethane	ND	0.020	0.020	ND	0.081	0.081		1
1,2-Dichloropropane	ND	0.020	0.020	ND	0.092	0.092		1
1,3-Butadiene	ND	0.020	0.020	ND	0.044	0.044		1
1,3-Dichlorobenzene	ND	0.020	0.020	ND	0.120	0.120		1
1,4-Dichlorobenzene	ND	0.020	0.020	ND	0.120	0.120		1
Benzene	ND	0.070	0.070	ND	0.224	0.224		1
Bromodichloromethane	ND	0.020	0.010	ND	0.134	0.067		1
Bromoform	ND	0.020	0.020	ND	0.207	0.207		1
Carbon tetrachloride	ND	0.020	0.020	ND	0.126	0.126		1
Chlorobenzene	ND	0.020	0.020	ND	0.092	0.092		1
Chloroform	ND	0.020	0.020	ND	0.098	0.098		1
cis-1,2-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
Ethylbenzene	ND	0.020	0.020	ND	0.087	0.087		1
Methylene chloride	ND	0.500	0.500	ND	1.74	1.74		1
Methyl tert butyl ether	ND	0.020	0.020	ND	0.072	0.072		1
Naphthalene	ND	0.050	0.025	ND	0.262	0.131		1
p/m-Xylene	ND	0.040	0.040	ND	0.174	0.174		1
o-Xylene	ND	0.020	0.020	ND	0.087	0.087		1
XYLENE (TOTAL)	ND	0.060	0.060	ND	0.261	0.261		1



**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108049**Project Number:** Not Specified**Report Date:** 08/05/11**Air Canister Certification Results**

Lab ID: L1108049-09

Date Collected: 06/08/11 00:00

Client ID: CAN 1619 FC 229

Date Received: 06/08/11

Sample Location:

Field Prep: Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
Tetrachloroethene	ND	0.020	0.020	ND	0.136	0.136		1
Toluene	ND	0.050	0.050	ND	0.188	0.188		1
trans-1,2-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
trans-1,3-Dichloropropene	ND	0.020	0.020	ND	0.091	0.091		1
Trichloroethene	ND	0.020	0.020	ND	0.107	0.107		1
Vinyl chloride	ND	0.020	0.020	ND	0.051	0.051		1
Isopropylbenzene	ND	0.500	0.500	ND	2.46	2.46		1

**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108049**Project Number:** Not Specified**Report Date:** 08/05/11**Air Canister Certification Results**

Lab ID: L1108049-09

Date Collected: 06/08/11 00:00

Client ID: CAN 1619 FC 229

Date Received: 06/08/11

Sample Location:

Field Prep: Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								

Internal Standard	% Recovery	Qualifier	Acceptance Criteria
1,4-difluorobenzene	90		60-140
bromochloromethane	112		60-140
chlorobenzene-d5	74		60-140



**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108049**Project Number:** Not Specified**Report Date:** 08/05/11**Air Canister Certification Results**

Lab ID: L1108049-11

Date Collected: 06/08/11 00:00

Client ID: CAN 995 FC 146

Date Received: 06/08/11

Sample Location:

Field Prep: Not Specified

Matrix: Air

Analytical Method: 48,TO-15-SIM

Analytical Date: 06/09/11 01:38

Analyst: RY

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
1,1,1-Trichloroethane	ND	0.020	0.020	ND	0.109	0.109		1
1,1,2-Trichloroethane	ND	0.020	0.020	ND	0.109	0.109		1
1,1-Dichloroethane	ND	0.020	0.020	ND	0.081	0.081		1
1,1-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
1,2,4-Trimethylbenzene	ND	0.020	0.020	ND	0.098	0.098		1
1,2-Dibromoethane	ND	0.020	0.010	ND	0.154	0.077		1
1,2-Dichloroethane	ND	0.020	0.020	ND	0.081	0.081		1
1,2-Dichloropropane	ND	0.020	0.020	ND	0.092	0.092		1
1,3-Butadiene	ND	0.020	0.020	ND	0.044	0.044		1
1,3-Dichlorobenzene	ND	0.020	0.020	ND	0.120	0.120		1
1,4-Dichlorobenzene	ND	0.020	0.020	ND	0.120	0.120		1
Benzene	ND	0.070	0.070	ND	0.224	0.224		1
Bromodichloromethane	ND	0.020	0.010	ND	0.134	0.067		1
Bromoform	ND	0.020	0.020	ND	0.207	0.207		1
Carbon tetrachloride	ND	0.020	0.020	ND	0.126	0.126		1
Chlorobenzene	ND	0.020	0.020	ND	0.092	0.092		1
Chloroform	ND	0.020	0.020	ND	0.098	0.098		1
cis-1,2-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
Ethylbenzene	ND	0.020	0.020	ND	0.087	0.087		1
Methylene chloride	ND	0.500	0.500	ND	1.74	1.74		1
Methyl tert butyl ether	ND	0.020	0.020	ND	0.072	0.072		1
Naphthalene	ND	0.050	0.025	ND	0.262	0.131		1
p/m-Xylene	ND	0.040	0.040	ND	0.174	0.174		1
o-Xylene	ND	0.020	0.020	ND	0.087	0.087		1
XYLENE (TOTAL)	ND	0.060	0.060	ND	0.261	0.261		1



**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108049**Project Number:** Not Specified**Report Date:** 08/05/11**Air Canister Certification Results**

Lab ID: L1108049-11

Date Collected: 06/08/11 00:00

Client ID: CAN 995 FC 146

Date Received: 06/08/11

Sample Location:

Field Prep: Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
Tetrachloroethene	ND	0.020	0.020	ND	0.136	0.136		1
Toluene	ND	0.050	0.050	ND	0.188	0.188		1
trans-1,2-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
trans-1,3-Dichloropropene	ND	0.020	0.020	ND	0.091	0.091		1
Trichloroethene	ND	0.020	0.020	ND	0.107	0.107		1
Vinyl chloride	ND	0.020	0.020	ND	0.051	0.051		1
Isopropylbenzene	ND	0.500	0.500	ND	2.46	2.46		1



**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108049**Project Number:** Not Specified**Report Date:** 08/05/11**Air Canister Certification Results**

Lab ID: L1108049-11

Date Collected: 06/08/11 00:00

Client ID: CAN 995 FC 146

Date Received: 06/08/11

Sample Location:

Field Prep: Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								

Internal Standard	% Recovery	Qualifier	Acceptance Criteria
1,4-difluorobenzene	82		60-140
bromochloromethane	122		60-140
chlorobenzene-d5	75		60-140

**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108049**Project Number:** Not Specified**Report Date:** 08/05/11**Air Canister Certification Results**

Lab ID: L1108049-18  
 Client ID: CAN 901 FC 131  
 Sample Location:  
 Matrix: Air  
 Analytical Method: 48,TO-15-SIM  
 Analytical Date: 06/09/11 23:48  
 Analyst: RY

Date Collected: 06/09/11 00:00  
 Date Received: 06/09/11  
 Field Prep: Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
1,1,1-Trichloroethane	ND	0.020	0.020	ND	0.109	0.109		1
1,1,2-Trichloroethane	ND	0.020	0.020	ND	0.109	0.109		1
1,1-Dichloroethane	ND	0.020	0.020	ND	0.081	0.081		1
1,1-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
1,2,4-Trimethylbenzene	ND	0.020	0.020	ND	0.098	0.098		1
1,2-Dibromoethane	ND	0.020	0.010	ND	0.154	0.077		1
1,2-Dichloroethane	ND	0.020	0.020	ND	0.081	0.081		1
1,2-Dichloropropane	ND	0.020	0.020	ND	0.092	0.092		1
1,3-Butadiene	ND	0.020	0.020	ND	0.044	0.044		1
1,3-Dichlorobenzene	ND	0.020	0.020	ND	0.120	0.120		1
1,4-Dichlorobenzene	ND	0.020	0.020	ND	0.120	0.120		1
Benzene	ND	0.070	0.070	ND	0.224	0.224		1
Bromodichloromethane	ND	0.020	0.010	ND	0.134	0.067		1
Bromoform	ND	0.020	0.020	ND	0.207	0.207		1
Carbon tetrachloride	ND	0.020	0.020	ND	0.126	0.126		1
Chlorobenzene	ND	0.020	0.020	ND	0.092	0.092		1
Chloroform	ND	0.020	0.020	ND	0.098	0.098		1
cis-1,2-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
Ethylbenzene	ND	0.020	0.020	ND	0.087	0.087		1
Methylene chloride	ND	0.500	0.500	ND	1.74	1.74		1
Methyl tert butyl ether	ND	0.020	0.020	ND	0.072	0.072		1
Naphthalene	ND	0.050	0.025	ND	0.262	0.131		1
p/m-Xylene	ND	0.040	0.040	ND	0.174	0.174		1
o-Xylene	ND	0.020	0.020	ND	0.087	0.087		1
XYLENE (TOTAL)	ND	0.060	0.060	ND	0.261	0.261		1



**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108049**Project Number:** Not Specified**Report Date:** 08/05/11**Air Canister Certification Results**

Lab ID: L1108049-18

Date Collected: 06/09/11 00:00

Client ID: CAN 901 FC 131

Date Received: 06/09/11

Sample Location:

Field Prep: Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
Tetrachloroethene	ND	0.020	0.020	ND	0.136	0.136		1
Toluene	ND	0.050	0.050	ND	0.188	0.188		1
trans-1,2-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
trans-1,3-Dichloropropene	ND	0.020	0.020	ND	0.091	0.091		1
Trichloroethene	ND	0.020	0.020	ND	0.107	0.107		1
Vinyl chloride	ND	0.020	0.020	ND	0.051	0.051		1
Isopropylbenzene	ND	0.500	0.500	ND	2.46	2.46		1

**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108049**Project Number:** Not Specified**Report Date:** 08/05/11**Air Canister Certification Results**

Lab ID: L1108049-18

Date Collected: 06/09/11 00:00

Client ID: CAN 901 FC 131

Date Received: 06/09/11

Sample Location:

Field Prep: Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								

Internal Standard	% Recovery	Qualifier	Acceptance Criteria
1,4-difluorobenzene	94		60-140
bromochloromethane	126		60-140
chlorobenzene-d5	78		60-140

**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108049**Project Number:** Not Specified**Report Date:** 08/05/11**Air Canister Certification Results**

Lab ID: L1108049-30  
 Client ID: CAN 1669 FC 353  
 Sample Location:  
 Matrix: Air  
 Analytical Method: 48,TO-15-SIM  
 Analytical Date: 06/11/11 15:02  
 Analyst: RY

Date Collected: 06/09/11 00:00  
 Date Received: 06/09/11  
 Field Prep: Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
1,1,1-Trichloroethane	ND	0.020	0.020	ND	0.109	0.109		1
1,1,2-Trichloroethane	ND	0.020	0.020	ND	0.109	0.109		1
1,1-Dichloroethane	ND	0.020	0.020	ND	0.081	0.081		1
1,1-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
1,2,4-Trimethylbenzene	ND	0.020	0.020	ND	0.098	0.098		1
1,2-Dibromoethane	ND	0.020	0.010	ND	0.154	0.077		1
1,2-Dichloroethane	ND	0.020	0.020	ND	0.081	0.081		1
1,2-Dichloropropane	ND	0.020	0.020	ND	0.092	0.092		1
1,3-Butadiene	ND	0.020	0.020	ND	0.044	0.044		1
1,3-Dichlorobenzene	ND	0.020	0.020	ND	0.120	0.120		1
1,4-Dichlorobenzene	ND	0.020	0.020	ND	0.120	0.120		1
Benzene	ND	0.070	0.070	ND	0.224	0.224		1
Bromodichloromethane	ND	0.020	0.010	ND	0.134	0.067		1
Bromoform	ND	0.020	0.020	ND	0.207	0.207		1
Carbon tetrachloride	ND	0.020	0.020	ND	0.126	0.126		1
Chlorobenzene	ND	0.020	0.020	ND	0.092	0.092		1
Chloroform	ND	0.020	0.020	ND	0.098	0.098		1
cis-1,2-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
Ethylbenzene	ND	0.020	0.020	ND	0.087	0.087		1
Methylene chloride	ND	0.500	0.500	ND	1.74	1.74		1
Methyl tert butyl ether	ND	0.020	0.020	ND	0.072	0.072		1
Naphthalene	ND	0.050	0.025	ND	0.262	0.131		1
p/m-Xylene	ND	0.040	0.040	ND	0.174	0.174		1
o-Xylene	ND	0.020	0.020	ND	0.087	0.087		1
XYLENE (TOTAL)	ND	0.060	0.060	ND	0.261	0.261		1



**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108049**Project Number:** Not Specified**Report Date:** 08/05/11**Air Canister Certification Results**

Lab ID: L1108049-30

Date Collected: 06/09/11 00:00

Client ID: CAN 1669 FC 353

Date Received: 06/09/11

Sample Location:

Field Prep: Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
Tetrachloroethene	ND	0.020	0.020	ND	0.136	0.136		1
Toluene	ND	0.050	0.050	ND	0.188	0.188		1
trans-1,2-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
trans-1,3-Dichloropropene	ND	0.020	0.020	ND	0.091	0.091		1
Trichloroethene	ND	0.020	0.020	ND	0.107	0.107		1
Vinyl chloride	ND	0.020	0.020	ND	0.051	0.051		1
Isopropylbenzene	ND	0.500	0.500	ND	2.46	2.46		1



**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108049**Project Number:** Not Specified**Report Date:** 08/05/11**Air Canister Certification Results**

Lab ID: L1108049-30

Date Collected: 06/09/11 00:00

Client ID: CAN 1669 FC 353

Date Received: 06/09/11

Sample Location:

Field Prep: Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								

Internal Standard	% Recovery	Qualifier	Acceptance Criteria
1,4-difluorobenzene	107		60-140
bromochloromethane	132		60-140
chlorobenzene-d5	85		60-140

**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108049**Project Number:** Not Specified**Report Date:** 08/05/11**Air Canister Certification Results**

**Lab ID:** L1108049-32  
**Client ID:** CAN 1672 FC 293  
**Sample Location:**  
**Matrix:** Air  
**Analytical Method:** 48,TO-15-SIM  
**Analytical Date:** 06/11/11 16:14  
**Analyst:** RY

**Date Collected:** 06/09/11 00:00  
**Date Received:** 06/09/11  
**Field Prep:** Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
1,1,1-Trichloroethane	ND	0.020	0.020	ND	0.109	0.109		1
1,1,2-Trichloroethane	ND	0.020	0.020	ND	0.109	0.109		1
1,1-Dichloroethane	ND	0.020	0.020	ND	0.081	0.081		1
1,1-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
1,2,4-Trimethylbenzene	ND	0.020	0.020	ND	0.098	0.098		1
1,2-Dibromoethane	ND	0.020	0.010	ND	0.154	0.077		1
1,2-Dichloroethane	ND	0.020	0.020	ND	0.081	0.081		1
1,2-Dichloropropane	ND	0.020	0.020	ND	0.092	0.092		1
1,3-Butadiene	ND	0.020	0.020	ND	0.044	0.044		1
1,3-Dichlorobenzene	ND	0.020	0.020	ND	0.120	0.120		1
1,4-Dichlorobenzene	ND	0.020	0.020	ND	0.120	0.120		1
Benzene	ND	0.070	0.070	ND	0.224	0.224		1
Bromodichloromethane	ND	0.020	0.010	ND	0.134	0.067		1
Bromoform	ND	0.020	0.020	ND	0.207	0.207		1
Carbon tetrachloride	ND	0.020	0.020	ND	0.126	0.126		1
Chlorobenzene	ND	0.020	0.020	ND	0.092	0.092		1
Chloroform	ND	0.020	0.020	ND	0.098	0.098		1
cis-1,2-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
Ethylbenzene	ND	0.020	0.020	ND	0.087	0.087		1
Methylene chloride	ND	0.500	0.500	ND	1.74	1.74		1
Methyl tert butyl ether	ND	0.020	0.020	ND	0.072	0.072		1
Naphthalene	ND	0.050	0.025	ND	0.262	0.131		1
p/m-Xylene	ND	0.040	0.040	ND	0.174	0.174		1
o-Xylene	ND	0.020	0.020	ND	0.087	0.087		1
XYLENE (TOTAL)	ND	0.060	0.060	ND	0.261	0.261		1



**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108049**Project Number:** Not Specified**Report Date:** 08/05/11**Air Canister Certification Results**

Lab ID: L1108049-32

Date Collected: 06/09/11 00:00

Client ID: CAN 1672 FC 293

Date Received: 06/09/11

Sample Location:

Field Prep: Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
Tetrachloroethene	ND	0.020	0.020	ND	0.136	0.136		1
Toluene	ND	0.050	0.050	ND	0.188	0.188		1
trans-1,2-Dichloroethene	ND	0.020	0.020	ND	0.079	0.079		1
trans-1,3-Dichloropropene	ND	0.020	0.020	ND	0.091	0.091		1
Trichloroethene	ND	0.020	0.020	ND	0.107	0.107		1
Vinyl chloride	ND	0.020	0.020	ND	0.051	0.051		1
Isopropylbenzene	ND	0.500	0.500	ND	2.46	2.46		1

**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108049**Project Number:** Not Specified**Report Date:** 08/05/11**Air Canister Certification Results**

Lab ID: L1108049-32

Date Collected: 06/09/11 00:00

Client ID: CAN 1672 FC 293

Date Received: 06/09/11

Sample Location:

Field Prep: Not Specified

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								

Internal Standard	% Recovery	Qualifier	Acceptance Criteria
1,4-difluorobenzene	106		60-140
bromochloromethane	128		60-140
chlorobenzene-d5	83		60-140

**Project Name:** UNIFIRST WELLS G&H**Lab Number:** L1108879**Project Number:** MA000989.0002.00003**Report Date:** 08/05/11**Sample Receipt and Container Information**

Were project specific reporting limits specified?

YES

**Reagent H2O Preserved Vials Frozen on:** NA**Cooler Information Custody Seal****Cooler**

N/A Present/Intact

**Container Information**

Container ID	Container Type	Cooler	pH	Temp deg C	Pres	Seal	Analysis(*)
L1108879-01A	Canister - 6 Liter	N/A	NA		Y	Present/Intact	TO15-SIM-UNI(30)
L1108879-02A	Canister - 6 Liter	N/A	NA		Y	Present/Intact	TO15-SIM-UNI(30)
L1108879-03A	Canister - 6 Liter	N/A	NA		Y	Present/Intact	TO15-SIM-UNI(30)
L1108879-04A	Canister - 6 Liter	N/A	NA		Y	Present/Intact	TO15-SIM-UNI(30)
L1108879-05A	Canister - 6 Liter	N/A	NA		Y	Present/Intact	TO15-SIM-UNI(30)
L1108879-06A	Canister - 6 Liter	N/A	NA		Y	Present/Intact	TO15-SIM-UNI(30)
L1108879-07A	Canister - 6 Liter	N/A	NA		Y	Present/Intact	TO15-SIM-UNI(30)

\*Values in parentheses indicate holding time in days

**Project Name:** UNIFIRST WELLS G&H  
**Project Number:** MA000989.0002.00003

**Lab Number:** L1108879  
**Report Date:** 08/05/11

## GLOSSARY

### Acronyms

EPA	- Environmental Protection Agency.
LCS	- Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LCSD	- Laboratory Control Sample Duplicate: Refer to LCS.
LFB	- Laboratory Fortified Blank: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
MDL	- Method Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The MDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
MS	- Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available.
MSD	- Matrix Spike Sample Duplicate: Refer to MS.
NA	- Not Applicable.
NC	- Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.
NI	- Not Ignitable.
RL	- Reporting Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
RPD	- Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.
SRM	- Standard Reference Material: A reference sample of a known or certified value that is of the same or similar matrix as the associated field samples.

### Footnotes

- 1 - The reference for this analyte should be considered modified since this analyte is absent from the target analyte list of the original method.

### Terms

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

### Data Qualifiers

- A** - Spectra identified as "Aldol Condensation Product".
- B** - The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than five times (5x) the concentration found in the blank. For MCP-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank.
- C** - Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.
- D** - Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.
- E** - Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.
- G** - The concentration may be biased high due to matrix interferences (i.e. co-elution) with non-target compound(s). The result should be considered estimated.
- H** - The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.
- I** - The RPD between the results for the two columns exceeds the method-specified criteria; however, the lower value has been reported due to obvious interference.
- M** - Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.
- P** - The RPD between the results for the two columns exceeds the method-specified criteria.
- Q** - The quality control sample exceeds the associated acceptance criteria. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less

**Report Format:** DU Report with "J" Qualifiers



**Project Name:** UNIFIRST WELLS G&H  
**Project Number:** MA000989.0002.00003

**Lab Number:** L1108879  
**Report Date:** 08/05/11

**Data Qualifiers**

than 5x the RL. (Metals only.)

**R** - Analytical results are from sample re-analysis.

**RE** - Analytical results are from sample re-extraction.

**J** - Estimated value. The Target analyte concentration is below the quantitation limit (RL), but above the Method Detection Limit (MDL). This represents an estimated concentration for Tentatively Identified Compounds (TICs).

**ND** - Not detected at the method detection limit (MDL) for the sample.

*Report Format:* DU Report with "J" Qualifiers

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**Project Name:** UNIFIRST WELLS G&H  
**Project Number:** MA000989.0002.00003

**Lab Number:** L1108879  
**Report Date:** 08/05/11

## REFERENCES

- 48 Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air. Second Edition. EPA/625/R-96/010b, January 1999.

## LIMITATION OF LIABILITIES

Alpha Analytical performs services with reasonable care and diligence normal to the analytical testing laboratory industry. In the event of an error, the sole and exclusive responsibility of Alpha Analytical shall be to re-perform the work at it's own expense. In no event shall Alpha Analytical be held liable for any incidental, consequential or special damages, including but not limited to, damages in any way connected with the use of, interpretation of, information or analysis provided by Alpha Analytical.

We strongly urge our clients to comply with EPA protocol regarding sample volume, preservation, cooling, containers, sampling procedures, holding time and splitting of samples in the field.





## Certificate/Approval Program Summary

Last revised August 4, 2011 – Mansfield Facility

The following list includes only those analytes/methods for which certification/approval is currently held. For a complete listing of analytes for the referenced methods, please contact your Alpha Customer Service Representative.

### **Connecticut Department of Public Health Certificate/Lab ID: PH-0141.**

*Wastewater/Non-Potable Water* (Inorganic Parameters: pH, Turbidity, Conductivity, Alkalinity, Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Strontium, Thallium, Tin, Vanadium, Zinc, Total Residue (Solids), Total Suspended Solids (non-filterable), Total Cyanide. Organic Parameters: PCBs, Organochlorine Pesticides, Technical Chlordane, Toxaphene, Acid Extractables, Benzidines, Phthalate Esters, Nitrosamines, Nitroaromatics & Isophorone, PAHs, Haloethers, Chlorinated Hydrocarbons, Volatile Organics.)

*Solid Waste/Soil* (Inorganic Parameters: pH, Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Calcium, Chromium, Hexavalent Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Thallium, Vanadium, Zinc, Total Organic Carbon, Total Cyanide, Corrosivity, TCLP 1311. Organic Parameters: PCBs, Organochlorine Pesticides, Technical Chlordane, Toxaphene, Volatile Organics, Acid Extractables, Benzidines, Phthalates, Nitrosamines, Nitroaromatics & Cyclic Ketones, PAHs, Haloethers, Chlorinated Hydrocarbons.)

### **Florida Department of Health Certificate/Lab ID: E87814. *NELAP Accredited.***

*Non-Potable Water* (Inorganic Parameters: SM2320B, SM2540D, SM2540G.)

*Solid & Chemical Materials* (Inorganic Parameters: 6020, 7470, 7471, 9045. Organic Parameters: EPA 8260, 8270, 8082, 8081.)

*Air & Emissions* (EPA TO-15.)

### **Louisiana Department of Environmental Quality Certificate/Lab ID: 03090. *NELAP Accredited.***

*Non-Potable Water* (Inorganic Parameters: EPA 180.1, 245.7, 1631E, 3020, 6020A, 7470A, 9040, 9050A, SM2320B, 2540D, 2540G, 4500H-B, Organic Parameters: EPA 3510C, 3580A, 3630C, 3640A, 3660B, 3665A, 5030B, 8015D, 3570, 8081B, 8082A, 8260B, 8270C, 8270D.)

*Solid & Chemical Materials* (Inorganic Parameters: EPA 1311, 3050, 3051A, 3060A, 6020A, 7196A, 7470A, 7471B, 7474, 9040B, 9045C, 9060. Organic Parameters: EPA 3540C, 3570B, 3580A, 3630C, 3640A, 3660, 3665A, 5035, 8015D, 8081B, 8082A, 8260B, 8270C, 8270D.)

*Biological Tissue* (Inorganic Parameters: EPA 6020A. Organic Parameters: EPA 3570, 3510C, 3610B, 3630C, 3640A, 8270C, 8270D.)

*Air & Emissions* (EPA TO-15.)

### **New Hampshire Department of Environmental Services Certificate/Lab ID: 2206. *NELAP Accredited.***

*Non-Potable Water* (Inorganic Parameters: EPA, 245.1, 245.7, 1631E, 180.1, 6020A, 7470A, 9040B, 9050A, SM2540D, 2540G, 4500H+B, 2320B. Organic Parameters: EPA 8081, 8082, 8260B, 8270C.)

*Solid & Chemical Materials* (Inorganic Parameters: SW-846 1311, 1312, 3050B, 3051A, 3060A, 6020A, 7470A, 7471A, 9040B, 9045C, 7196A. Organic Parameters: SW-846 3540C, 3580, 3630C, 3640A, 3660B, 3665A, 5035, 8260B, 8270C, 8015D, 8082, 8081A.)

### **New Jersey Department of Environmental Protection Certificate/Lab ID: MA015. *NELAP Accredited.***

*Non-Potable Water* (Inorganic Parameters: SW-846 1312, 3010, 3020A, 3015, SM2320B, SM2540D, 2540G, , EPA 180.1, 1631E, SW-846 7470A, 9040B, 6020. Organic Parameters: SW-846 3510C, 3580A, 5030B, 5035L, 5035H, 3630C, 3640C, 3660B, 3665A, 8015B 8081A, 8082, 8260B, 8270C)

*Solid & Chemical Materials* (Inorganic Parameters: SW-846 6020, 1311, 1312, 3050B, 3051, 3060A, 7196A, 7470A, 7471A, 9040B, 9045C, 9050A, 9060. Organic Parameters: SW-846 3540C, 3570, 3580A, 5030B, 5035L, 5035H, 3630C, 3640A, 3660B, 3665A, 8081A, 8082, 8260B, 8270C, 8015B.)

*Atmospheric Organic Parameters* (EPA TO-15)

*Biological Tissue* (Inorganic Parameters: SW-846 6020 Organic Parameters: SW-846 8270C, 3510C, 3570, 3610C, 3630C, 3640A)

**New York Department of Health** Certificate/Lab ID: 11627. **NELAP Accredited.**

*Non-Potable Water* (Inorganic Parameters: SM2320B, SM2540D, EPA 200.8, 6020, 1631E, 245.1, 245.7, 7470A, 9014, 9040B, 9050, 120.1, 4500CN-E, 4500H-B, EPA 376.2, 180.1, 3020A. Organic Parameters: EPA 8260B, 8270C, 8081A, 8082, 3510C, 5030B.)

*Solid & Hazardous Waste* (Inorganic Parameters: EPA 6020, 7196A, 3060A, 7471A, 7474, 9014, 9040B, 9045C, 9010B. Organic Parameters: EPA 8260B, 8270C, 8081A, DRO 8015B, 8082, 1311, 1312, 3050B, 3580, 3570, 3051, 5035, 5030B.)

*Air & Emissions* (EPA TO-15.)

**Rhode Island Department of Health** Certificate/Lab ID: LAO00299. **NELAP Accredited via LA-DEQ.**

Refer to LA-DEQ Certificate for Non-Potable Water.

**Texas Commission of Environmental Quality** Certificate/Lab ID: T104704419-08-TX. **NELAP Accredited.**

*Solid & Chemical Materials* (Inorganic Parameters: EPA 6020, 7470, 7471, 1311, 7196, 9040, 9045, 9060. Organic Parameters: EPA 8015, 8270, 8260, 8081, 8082.)

*Air* (Organic Parameters: EPA TO-15)

**Washington State Department of Ecology** Certificate/Lab ID: C954. *Non-Potable Water* (Inorganic Parameters: SM2540D, 2510B, EPA 120.1, 180.1, 1631E, 245.7.)

*Solid & Chemical Materials* (Inorganic Parameters: EPA 9040, 9060, 6020, 7470, 7471, 7474. Organic Parameters: EPA 8081, 8082, 8015 Mod, 8270, 8260.)

**U.S. Army Corps of Engineers**

**Department of Defense** Certificate/Lab ID: L2217.01.

*Non-Potable Water* (Inorganic Parameters: EPA 6020A, SM4500H-B. Organic Parameters: 3020A, 3510C, 5030B, 8260B, 8270C, 8270C-ALK-PAH, 8082, 8081A, 8015D-SHC.)

*Solid & Hazardous Waste* (Inorganic Parameters: EPA 1311, 1312, 3050B, 6020A, 7471A, 9045C, 9060, SM 2540G, ASTM D422-63. Organic Parameters: EPA 3580A, 3570, 3540C, 5035A, 8260B, 8270C, 8270-ALK-PAH, 8082, 8081A, 8015D-SHC, 8015-DRO.

*Air & Emissions* (EPA TO-15.)

**Analytes Not Accredited by NELAP**

Certification is not available by NELAP for the following analytes: **8270C**: Biphenyl. **TO-15**: Halothane, 2,4,4-Trimethyl-2-pentene, 2,4,4-Trimethyl-1-pentene, Thiophene, 2-Methylthiophene, 3-Methylthiophene, 2-Ethylthiophene, 1,2,3-Trimethylbenzene, Indan, Indene, 1,2,4,5-Tetramethylbenzene, Benzothiophene, 2-Methylnaphthalene, 1-Methylnaphthalene.



## CHAIN OF CUSTODY

## AIR ANALYSIS

320 Forbes Blvd, Mansfield, MA 02048  
TEL: 508-822-9300 FAX: 508-822-3288

PAGE 1 OF 2

Date Rec'd in Lab:

ALPHA Job #: 61108879

## Project Information

Project Name: *Unifirst Wells G4H*Project Location: *Woburn, MA*Project #: *MA000909-0002-0003*

Project Manager:

ALPHA Quote #:

## Turn-Around Time

☒ Standard☐ RUSH (only confirmed if pre-approved!)

Date Due:

Time:

## Report Information - Data Deliverables

☐ FAX☐ ADEX

Criteria Checker:

(Default based on Regulatory Criteria Indicated)

Other Formats:

☐ EMAIL (standard pdf report)☐ Additional Deliverables:

Report to: (if different than Project Manager)

## Billing Information

☐ Same as Client info

PO #:

## Regulatory Requirements/Report Limits

State/Fed Program Criteria

## Client Information

Client: *ARCADIS*Address: *482 Congress Suite 501  
Portland, ME 04101*Phone: *207-828-0046*Fax: *207-828-0062*Email: *Witch-whd-sun@arcadis-us.com*☐ These samples have been previously analyzed by Alpha

Other Project Specific Requirements/Comments:

## All Columns Below Must Be Filled Out

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection										TO-14A	TO-15	TO-15	APH	FIXED	TO-13	TO-4	Sample Comments (i.e. PID)
		Date	Start Time	End Time	Initial Vacuum	Final Vacuum	Sample Matrix*	Sampler's Initials	Can Size	ID Can	ID - Flow Controller								
8879.1	AA-570-1-06162011	6/16	6/17	0950	0952	-30"	-6.3	AA	MW	6L	995	481			X				
2	IA-70-3-06162011	6/16	6/17	0953	0954	-30"	-8.1"	AA	MW	6L	648	124			X				
3	IA-70-2-06162011	6/16	6/17	0959	0957	-24.8"	-5.2"	AA	MW	6L	1619	224			X				
4	IA-70-1-06162011	6/16	6/17	1001	0958	-30"	-6.3	AA	MW	6L	901	131			X				
	IA-50-4-06162011	6/16	6/17	1006	1001	-30"	-6.4"	AA	MW	6L	686	192			X				
	IA-50-5-06162011	6/16	6/17	1009	1002	-30"	-5.1"	AA	MW	6L	575	152			X				
5	SS-70-1-06172011	6/17	6/17	1049	1119	-24.7"	-5.4"	SV	MW	6L	1672	293			X				
6	SS-70-2-06172011	6/17	6/17	1124	1154	-24.3"	-6.3"	SV	MW	6L	1669	363			X				
	SS-50-4-06172011	6/17	6/17	1132	1302	-29.6	-6.4	SV	MW	6L	1658	073			X				
	Dup SS 06172011	6/17	6/17	—	—	-21.9	-6.4	SV	MW	6L	748	391			X				

## \*SAMPLE MATRIX CODES

AA = Ambient Air (Indoor/Outdoor)

SV = Soil Vapor/Landfill Gas/SVE

Other = Please Specify

Container Type

Relinquished By:

Date/Time

Received By:

Date/Time:



## CHAIN OF CUSTODY

## AIR ANALYSIS

PAGE

2 OF 2

320 Forbes Blvd, Mansfield, MA 02048  
TEL: 508-822-9300 FAX: 508-822-3288

## Client Information

Client: ARCADIS  
Address: 482 Congress St Suite 501  
Portland ME 04101  
Phone: 207-828-0046  
Fax: 207-828-0062  
Email: Mitch.Watson@Arcadis-usa.com

☐ These samples have been previously analyzed by Alpha

## Project Information

Project Name: Unfirst wells G&H  
Project Location: Woburn, MA  
Project #: MA000989,0002 0003  
Project Manager:  
ALPHA Quote #:

## Turn-Around Time

☒ Standard ☐ RUSH (only confirmed if pre-approved)

Date Due:

Time:

Other Project Specific Requirements/Comments:

Date Rec'd in Lab:

ALPHA Job #: 01108879

## Report Information - Data Deliverables

- ☐ FAX  
☐ ADEX

Criteria Checker:

(Default based on Regulatory Criteria Indicated)

Other Formats:

- ☐ EMAIL (standard pdf report)  
☐ Additional Deliverables:

Report to: (If different than Project Manager)

## Billing Information

☐ Same as Client info PO #:

## Regulatory Requirements/Report Limits

State/Fed	Program	Criteria

## ANALYSIS

## All Columns Below Must Be Filled Out

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection						Sample Matrix*	Sampler's Initials	Can Size	I D Can	I D - Flow Controller	TO-14	TO-15	TO-15 APH	FIXED	TO-13	TO-4	Sample Comments (i.e. PID)
		Date	Start Time	End Time	Initial Vacuum	Final Vacuum													
8879.7	SS-505-06172011	6/17	1258	1328	-30"	-6.2"	SV	MW	GL	156	052			X					
	TB06172011	6/17	—	—	—	—	AA	MW	GL	164	149			X					

## \*SAMPLE MATRIX CODES

AA = Ambient Air (Indoor/Outdoor)  
SV = Soil Vapor/Landfill Gas/SVE  
Other = Please Specify

Container Type:

Relinquished By:

Date/Time

Received By:

Date/Time



# AIR ANALYSIS

## CHAIN OF CUSTODY

PAGE 1 OF       Date Rec'd in Lab:                     ALPHA Job #:                     320 Forbes Blvd, Mansfield, MA 02048  
TEL: 508-822-9300 FAX: 508-822-3288**Client Information**Client: ArcadisAddress:                                     Phone:                     Fax:                     Email:                     ☐ These samples have been previously analyzed by Alpha**Project Information**Project Name:                     Project Location: Unifirst SU1

Project #:

Project Manager:

ALPHA Quote #:

**Turn-Around Time**☐ Standard☐ RUSH (only confirmed if pre-approved!)Date Due:                     Time:                     **Report Information - Data Deliverables**☐ FAX☐ ADEXCriteria Checker:                     

(Default based on Regulatory Criteria Indicated)

Other Formats:                     ☐ EMAIL (standard pdf report)☐ Additional Deliverables:                     Report to: (if different than Project Manager)                     **Billing Information**☐ Same as Client infoPO #:                     **Regulatory Requirements/Report Limits**

State/Fed

Program

Criteria

**All Columns Below Must Be Filled Out**

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection			Initial Vacuum	Final Vacuum	Sample Matrix*	Sampler's Initials	Can Size	I D Can	I D - Flow Controller	ANALYSIS						Sample Comments (i.e. PID)
		Date	Start Time	End Time								TO-14A by TO-15	TO-15	TO-15 SIM	APH	FIXED GASES	TO-13A	
	Can 959 FC 248	6/13/11			-29.4		AA											
	Can 1592 FC 168				-29.4													
	Can 648 FC 129				-29.4													
	Can 1691 FC 149				-29.4													
	Can 1688 FC 326				-29.4													
	Can 947 FC 071				-29.4													
	Can 640 FC 286				-29.4													
	Can 1619 FC 229				-29.4													
	Can 643 FC 359				-29.4													
	Can 995 FC 481				-29.4													

**\*SAMPLE MATRIX CODES**

AA = Ambient Air (Indoor/Outdoor)

SV = Soil Vapor/Landfill Gas/SVE

Other = Please Specify

Container Type

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Terms and Conditions. See reverse side.





# AIR ANALYSIS

CHAIN OF CUSTODY

320 Forbes Blvd, Mansfield, MA 02048  
TEL: 508-822-9300 FAX: 508-822-3288

## Client Information

Client: Arcad's

Address:

Phone:

Fax:

Email:

☐ These samples have been previously analyzed by Alpha

Other Project Specific Requirements/Comments:

PAGE 3 OF       

Date Rec'd in Lab:

ALPHA Job #:

## Project Information

Project Name:

Project Location: Unifirst SU1

Project #:

Project Manager:

ALPHA Quote #:

## Turn-Around Time

☐ Standard

☐ RUSH (only confirmed if pre-approved!)

Date Due:

Time:

## Report Information - Data Deliverables

☐ FAX

☐ ADEx

Criteria Checker: \_\_\_\_\_

(Default based on Regulatory Criteria Indicated)

Other Formats: \_\_\_\_\_

☐ EMAIL (standard pdf report)

☐ Additional Deliverables: \_\_\_\_\_

Report to: (if different than Project Manager)

## Billing Information

☐ Same as Client Info

PO #:

## Regulatory Requirements/Report Limits

State/Fed	Program	Criteria
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## ANALYSIS

## All Columns Below Must Be Filled Out

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection					Sample Matrix*	Sampler's Initials	Can Size	I D Can	I D - Flow Controller	TO-14A by TO-15	TO-15	TO-15 SIM	APH	FIXED GASES	TO-13A	TO-4 / TO-10	Sample Comments (i.e. PID)
		Date	Start Time	End Time	Initial Vacuum	Final Vacuum													
	Con 742 FC 223	6/13/11			-29.4		SU												
	Con 748 FC 391				-29.4														
	Con 1658 FC 073				-29.4														
	Con 1644 FC 279				-29.4														
	Con 1669 FC 353				-29.4														
	Con 1568 FC 295				-29.4														
	Con 1672 FC 293				-29.4														
	Con 1565 FC 052				-29.4														
	Con 1695 FC 300				-29.4														① 6/13/11

## \*SAMPLE MATRIX CODES

AA = Ambient Air (Indoor/Outdoor)

SV = Soil Vapor/Landfill Gas/SVE

Other = Please Specify

Container Type

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Terms and Conditions. See reverse side.

Relinquished By:

Date/Time

Received By:

Date/Time

P. Gilbert  
P. Gilbert  
M. Green

6/13/11 16:20  
6/13/11 16:55  
6/13/11 16:55  
6-14-11

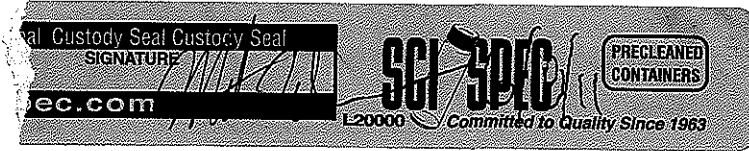
P. Gilbert  
M. Green  
W. Green

6/13/11 16:20  
6/13/11 16:55  
6-14-11 10:20  
6-14-11 13:15

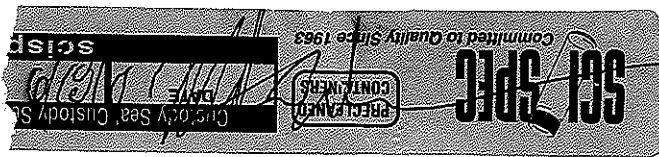




only half  
seal on crate.  
Covering Seam.



same as above







## **Appendix E**

Preliminary Human Health Risk  
Evaluation Report

**UniFirst Corporation**

## **Appendix E**

### **Human Health Risk Evaluation Report – Second Sampling Round**

**Residence, Parcel 26/ 05/ 05 – North  
Wells G&H Superfund Site  
Woburn, Massachusetts**

August 2011



**Appendix E  
Human Health Risk Evaluation  
Report – Second Sampling  
Round**

Residence, Parcel 26/ 05/ 05 – North  
Wells G&H Superfund Site  
Woburn, Massachusetts

Prepared for:  
UniFirst Corporation

Prepared by:  
ARCADIS U.S., Inc.  
482 Congress St  
Suite 501  
Portland  
Maine 04101  
Tel 207.828.0046  
Fax 207.828.0062

Our Ref.:  
MA000989.0002

Date:  
August 2011

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Table 2	Residential Indoor Air and Sub-slab Soil Vapor Data with Attenuation Factors
Table 3	Exposure Assumptions for the Estimation of Risks from Inhalation of Volatile Constituents in Indoor Air for a Resident
Table 4	Estimated Risks to a Resident from Short Term Exposure to Volatile Constituents in Indoor Air via Inhalation
Table 5	Estimated Risks to a Resident from Long Term Exposure to Volatile Constituents in Indoor Air via Inhalation
Table 6	Estimated Risks to a Resident from Short Term Exposure to Volatile Constituents in Indoor Air via Inhalation – Combined Results
Table 7	Estimated Risks to a Resident from Long Term Exposure to Volatile Constituents in Indoor Air via Inhalation – Combined Results

**Attachment**

A	Risk Tables
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## **1. Introduction**

ARCADIS has prepared a preliminary human health risk assessment based upon validated indoor air data presented in Table 1 of the Indoor Air Quality and Vapor Intrusion Assessment: Report of Second Round of Sampling Results Residence; Parcel 26/05/05 – North from samples collected on June 16-17, 2011 at the northern half of the residential duplex at Woburn Parcel Number 26/05/05 (the Residence). The list of compounds of potential concern (COPCs) is in accordance with Table 1 of the *Indoor Air Quality and Vapor Intrusion Assessment Scope of Work (SOW)* (The Johnson Company [JCO] 2010a) submitted to the United States Environmental Protection Agency (USEPA) by JCO on behalf of the UniFirst Corporation in March 2010 and Table 2 of *Indoor Air Quality and Vapor Intrusion Assessment: Report of Results (IAQA/VI)* (JCO 2010b). COPCs that were detected in any indoor air sample were considered in the risk assessment.

## **2. Comparison to Acute Exposure Criteria**

In order to screen for potential near-term human health hazards, indoor air data from June 2011 were compared to two sets of acute exposure criteria, including Acute Minimal Risk Levels (MRLs) and Acute Exposure Guideline Levels (AEGLs). In addition, indoor air data were compared to occupational criteria, including Permissible Exposure Limits (PELs) and Threshold Limit Values (TLVs®) (Table 1). Acute inhalation MRLs are derived by the Agency for Toxic Substances and Disease Registry (ATSDR) for noncarcinogenic effects from exposures lasting 14 days or less. AEGLs are set by USEPA for infrequent or one-time exposures to airborne compounds. An eight-hour AEGL-1 represents a level above which it is expected that the general population could experience significant but reversible irritation or discomfort. PELs are federal standards enforceable by the Occupational Safety and Health Administration (OSHA) for an eight-hour time-weighted average occupational exposure. TLVs® are eight-hour time-weighted averages proposed by the American Conference of Governmental Industrial Hygienists (ACGIH) for occupational hazard assessment. If no acute exposure criteria or occupational criteria were available for a given compound, surrogate values were used where appropriate (Table 1). Comparisons were based on individual samples (i.e., assuming that an individual person would consistently remain at the sample location throughout the relevant exposure period).

No June 2011 result exceeded acute exposure criteria. Thus, acute indoor air exposures to the COPCs would not pose significant risks of harm to human health.

### **3. Risk Evaluation**

Indoor air and outdoor air samples were collected at the Residence on June 16 and 17, 2011. Subslab soil vapor samples were collected on June 17, 2011. The indoor air samples were collected at two locations in the basement and one location on the first floor of the Residence. Analytical results indicate that nine constituents were detected in indoor air (Table 2). Of these nine constituents, 1,2-dichloroethane, benzene, ethylbenzene, naphthalene, and toluene were detected only in indoor air and not in sub-slab soil vapor, indicating that concentrations detected were associated with background sources.

Four of the nine constituents detected in indoor air were also detected in sub-slab soil vapor, including 1,2,4-trimethylbenzene, carbon tetrachloride, chloroform, and xylenes (Table 2). Calculated attenuation factors (AF) were close to or above 1.0 for 1,2,4-trimethylbenzene, carbon tetrachloride, chloroform, and xylenes, indicating these compounds were detected at similar concentrations in indoor air and sub-slab soil vapor or higher concentrations in indoor air and are therefore primarily associated with background sources.

Two chemicals were detected in sub-slab soil vapor only, including 1,1,1-trichloroethane and tetrachloroethene (PCE).

During pre-sampling activities, ARCADIS staff conducted a building survey to document building conditions and products that were found in both the basement and the first floor of the Residence. The second floor of the Residence was not included in the building survey, where additional background sources of some chemicals may be located. The following potential background sources were identified during the survey:

- Cleaning products containing bleach were noted in the home during the site visit, which may be a source of chloroform via reactions with other cleaning products (Odabasi 2008).
- Spray paint canisters were noted during the building survey. These could be sources of toluene and xylenes.
- Various other cleaning products and aerosols were also noted.

Risks from inhalation of volatile organic compounds in indoor air were estimated for a current resident for both long- and short-term exposures. Exposure assumptions were based on current USEPA guidance (USEPA 2009) (Table 3).

In accordance with USEPA guidance, long-term exposure was defined as 30 years for a current resident. The short-term exposure was performed for a five-year exposure in accordance with Massachusetts Department of Environmental Protection (MADEP) guidance for Imminent Hazard (IH) evaluations to determine if an IH condition existed as defined in the Massachusetts Contingency Plan (MCP) (MADEP 2008a). As specified in the MCP, the IH evaluation was performed for current use receptors: current residents.

For each constituent, the exposure point concentration in indoor air is equal to the average concentration of the three indoor air results. Residents were assumed to be present 24 hours per day in the building. Exposure parameters for each scenario are presented in Table 3.

Risks were estimated according to USEPA (2009) guidance and the MCP (MADEP 2008a). Volatile organic compounds in indoor air were not considered to pose significant cumulative risk to human health within or below the USEPA Superfund target excess lifetime cancer risk range of  $1 \times 10^{-6}$  to  $1 \times 10^{-4}$  for potential carcinogenic effects and a target Hazard Index (HI) of 1 for potential noncarcinogenic effects. The criteria applicable to the MADEP IH evaluation are a target excess lifetime cancer risk of  $1 \times 10^{-5}$  for potential carcinogenic effects and a target HI of 1 for potential noncarcinogenic effects.

The risk assessment was executed on all constituents that were detected in at least one indoor air sample, including several constituents that have been demonstrated *not* to be site-related. 1,2,4-trimethylbenzene, benzene, carbon tetrachloride, and toluene were detected at similar concentrations in outdoor air compared to indoor air, so ambient air may have contributed to background concentrations. 1,2,4-trimethylbenzene, carbon tetrachloride, chloroform, and xylenes were detected at roughly equal or greater concentrations in indoor air than sub-slab soil vapor. These constituents are present as a result of sources within the building and are not within the scope of a release to the environment addressed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

Risks from an initial sampling event at this property (April 21-22, 2011) were presented in Appendix E of the Indoor Air Quality and Vapor Intrusion Assessment: Report of

Results submitted to USEPA on May 23, 2011. To evaluate potential risks over both the initial sampling event (April 2011) and the second round of sampling (June 16 and 17, 2011), risks were calculated considering chemicals detected in indoor air from both events. Any constituent that was detected in either the April or June in indoor air sampling was included in the combined risk calculation. Risks were estimated using the average concentration from both sampling rounds. Risks associated with both data sets are referred to as “Combined Results” below.

#### **4. Current Results**

No indoor air sample exceeded acute exposure criteria or occupational criteria, and acute indoor air exposures to the COPCs are not estimated to pose significant risks to human health.

##### **4.1 Current Resident (Short-Term)**

As presented in Table 4, the cumulative estimated lifetime cancer risks for a short-term (five-year) exposure period to a current resident exposed to the average concentrations of COPCs detected in indoor air in the Residence did not exceed the MADEP IH target risk level of  $1 \times 10^{-5}$  (Table 4). Cumulative non-cancer hazards are equal to 0.1 for this exposure scenario. No IH condition as defined by the MCP was found to exist at the Residence for the short-term resident exposure scenario.

All risks to COPCs in indoor air were within the Superfund target excess lifetime cancer risk range of  $1 \times 10^{-6}$  to  $1 \times 10^{-4}$  and no individual chemical risk exceeded  $5 \times 10^{-7}$  (Table 4). It should be noted that 70% of the risk was due to exposure to constituents that were not detected in any sub-slab soil vapor sample – 1,2-dichloroethane, benzene, ethylbenzene, and naphthalene. Risks from carbon tetrachloride and chloroform account for the other 31% of total risk; these constituents are likely attributable to background sources. PCE was not detected in indoor air in the current sampling.

##### **4.2 Current Resident (Long-Term)**

Cumulative estimated cancer risks for a long-term (30-year) exposure period to a current resident exposed to the average concentrations of COPCs detected in indoor air were within the Superfund target excess lifetime cancer risk range of  $1 \times 10^{-6}$  to  $1 \times 10^{-4}$  (Table 5). Cumulative non-cancer hazards are equal to 0.1 for this exposure scenario. Constituents not detected in sub-slab soil vapor (1,2-dichloroethane,



benzene, ethylbenzene, naphthalene) make up the majority of the risk (70%). PCE was not detected in indoor air in the current sampling.

## **5. Combined Results**

The results from the April 2011 and June 2011 data were combined to determine the potential overall risk from exposure to constituents detected in indoor air.

### **5.1 Current Resident (Short-Term)**

Table 6 presents the results of the combined indoor air data evaluation. The cumulative estimated lifetime cancer risks for a short-term (five-year) exposure period to a current resident exposed to the COPCs detected in indoor air from April and June 2011 in the Residence did not exceed the MADEP IH target risk level of  $1 \times 10^{-5}$  (Table 6). Non-cancer hazards for the combined results are equal to 0.2 for this exposure scenario. No IH condition as defined by the MCP was found to exist at the Residence for the short-term resident exposure scenario.

All risks to COPCs in indoor air from the combined results were within the Superfund target excess lifetime cancer risk range of  $1 \times 10^{-6}$  to  $1 \times 10^{-4}$  and no individual chemical risks exceeded  $5 \times 10^{-7}$  (Table 6). It should be noted that the majority of risk (84%) from the combined results was due to exposure to 1,2-dichloroethane, 1,3-butadiene, benzene, chloroform, and naphthalene which are likely to be present in indoor air from background sources. Risk associated with PCE from the combined sampling results only accounts for 4% of the total risk, or an estimated risk level of  $8 \times 10^{-8}$  over both sampling events.

### **5.2 Current Resident (Long-Term)**

Cumulative estimated cancer risks for a long-term (30-year) exposure period to a current resident exposed to COPCs in indoor air from the combined results were within the Superfund target excess lifetime cancer risk range of  $1 \times 10^{-6}$  to  $1 \times 10^{-4}$  (Table 7). Non-cancer hazards are equal to 0.2 for this exposure scenario (Table 7). 1,2-Dichloroethane, 1,3-butadiene, benzene, chloroform, and naphthalene continue to drive the estimated risk level, again making up 84% of risk. The risk associated with exposure to PCE in indoor air from the combined results is  $5 \times 10^{-7}$  for the long term current resident.

## **6. Conclusions and Recommendations**

In the June 2011 sampling round, no indoor air sample exceeded acute exposure criteria or occupational criteria, and acute indoor air exposures to the COPCs are not estimated to pose significant risks to human health. Cumulative estimated carcinogenic and noncarcinogenic risks for current residents did not exceed target risk levels for a short-term (five-year) exposure period. No IH condition as defined by the MCP was found to exist at the Residence.

Long term estimated excess lifetime carcinogenic risks for current residents (30 years) are all within the Superfund target excess lifetime cancer risk range of  $1 \times 10^{-6}$  to  $1 \times 10^{-4}$  considering average indoor air concentrations and do not exceed  $1 \times 10^{-5}$  under any exposure scenario. All non-cancer HIs are below 1. All supporting risk assessment tables are provided in Attachment A.

PCE was not detected in indoor air in the June 2011 sampling event. According to MADEP, when compounds of concern are measured in indoor air at levels that are below TVs, it can reasonably be concluded that a complete vapor intrusion pathway does not exist.

The risk evaluation of the combined data confirms the results reported above and in the previous (May 23, 2011) human health risk assessment. Using all the data, the overall risk level was similar to the current data set. In all cases, background constituents are the primary risk driver in indoor air (see Section 3.3 of the Indoor Air and Vapor Intrusion Assessment). In contrast, PCE only accounts for a small percentage (4%) of the overall risk level in the combined results and was not detected in the June 2011 sampling round. Concentrations of background constituents detected in indoor air were slightly higher in the June 2011 samples than in the April 2011 samples. The average indoor air PCE concentration dropped considerably from the April 2011 sampling event, because PCE was not detected at all in the June 2011 sampling event.

## **7. References**

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**Appendix E  
Human Health Risk  
Evaluation Report –  
Second Sampling Round**

Residence, Parcel 26/ 05/ 05 – North  
Wells G&H Superfund Site  
Woburn, Massachusetts

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**Table 1. Acute and Occupational Exposure Criteria for COPCs Detected in Indoor Air**

Compound	ATSDR MRL	USEPA AEGL	OSHA PEL	ACGIH TLV
1,2,4-Trimethylbenzene	NA	2.21E+05	NA	1.23E+05
1,2-Dichloroethane	NA	NA	2.02E+05	NA
Benzene	2.87E+01	2.87E+04	3.19E+04	1.60E+03
Carbon tetrachloride	NA	1.20E+05	6.30E+04	3.15E+04
Chloroform	4.87E+02	1.41E+05	2.40E+05	4.87E+04
Ethylbenzene	4.34E+04	1.43E+05	4.35E+05	4.34E+05
Naphthalene	NA	NA	5.00E+04	5.24E+04
Tetrachloroethene	1.36E+03	2.38E+05	6.79E+05	1.70E+05
Toluene	3.76E+03	7.53E+05	7.53E+05	7.53E+04
Xylenes	8.67E+03	5.64E+05	4.35E+05	4.34E+05

**Notes:**

All levels in  $\mu\text{g}/\text{m}^3$ . Levels reported in parts per million (ppm) were first converted to  $\text{mg}/\text{m}^3$ :

$(\text{level in ppm}) \times (\text{molecular weight}) / 24.45$ .

COPC = compound of potential concern

NA = value not available

ATSDR MRL = Agency for Toxic Substances and Disease Registry Minimum Risk Level (acute inhalation exposure)

USEPA AEGL = US Environmental Protection Agency Acute Exposure Guideline Level (8-hour AEGL 1; AEGL 2 if AEGL 1 not reported).

OSHA PEL = Occupational Safety and Health Administration Permissible Exposure Limits (29 CFR 1910 Subpart Z)

ACGIH TLV = American Conference of Governmental Industrial Hygienists Threshold Limit Value® (time-weighted average)

**Table 2. Residential Indoor Air and Sub-slab Soil Vapor Data with Attenuation Factors**

Sample Name: Location: Date Collected:	Units	IA-1 Basement 6/17/2011	IA-2 Basement 6/17/2011	IA-3 1st Floor 6/17/2011	Average Detected Concentration in Indoor Air	SS-1 Sub-Slab 6/17/2011	SS-2 Sub-Slab 6/17/2011	Average Detected Concentration Sub- Slab Soil Vapor	OA-1 Outdoor 6/17/2011	Average Attenuation Factor (a) Sub- Slab to
1,1,1-Trichloroethane	µg/m <sup>3</sup>	0.109 U	0.109 U	0.109 U	ND	0.273	0.153	0.213	0.109 U	NA
1,1,2-Trichloroethane	µg/m <sup>3</sup>	0.109 U	0.109 U	0.109 U	ND	0.109 U	0.109 U	ND	0.109 U	NA
1,1-Dichloroethane	µg/m <sup>3</sup>	0.081 U	0.081 U	0.081 U	ND	0.081 U	0.081 U	ND	0.081 U	NA
1,1-Dichloroethene	µg/m <sup>3</sup>	0.079 U	0.079 U	0.079 U	ND	0.079 U	0.079 U	ND	0.079 U	NA
1,2,4-Trimethylbenzene	µg/m <sup>3</sup>	0.256	0.256	0.177	0.230	0.221	0.098 U	<b>0.221</b>	0.226	1.04
1,2-Dibromoethane	µg/m <sup>3</sup>	0.154 U	0.154 U	0.154 U	ND	0.154 U	0.154 U	ND	0.154 U	NA
1,2-Dichloroethane	µg/m <sup>3</sup>	0.202	0.162	0.461	0.275	0.081 U	0.081 U	ND	0.081 U	NA
1,2-Dichloropropane	µg/m <sup>3</sup>	0.092 U	0.092 U	0.092 U	ND	0.092 U	0.092 U	ND	0.092 U	NA
1,3-Butadiene	µg/m <sup>3</sup>	0.044 UJ	0.044 UJ	0.044 UJ	ND	0.044 UJ	0.044 UJ	ND	0.044 UJ	NA
1,3-Dichlorobenzene	µg/m <sup>3</sup>	0.12 U	0.12 U	0.12 U	ND	0.12 U	0.12 U	ND	0.12 U	NA
1,4-Dichlorobenzene	µg/m <sup>3</sup>	0.12 U	0.12 U	0.12 U	ND	0.12 U	0.12 U	ND	0.12 U	NA
Benzene	µg/m <sup>3</sup>	0.316	0.345	0.278	0.313	0.224 U	0.224 U	ND	0.249	NA
Bromodichloromethane	µg/m <sup>3</sup>	0.134 U	0.134 U	0.134 U	ND	0.134 U	0.134 U	ND	0.134 U	NA
Bromoform	µg/m <sup>3</sup>	0.207 U	0.207 U	0.207 U	ND	0.207 U	0.207 U	ND	0.207 U	NA
Carbon Tetrachloride	µg/m <sup>3</sup>	0.421	0.465	0.459	0.448	0.145	0.126 U	<b>0.145</b>	0.472	3.09
Chlorobenzene	µg/m <sup>3</sup>	0.092 U	0.092 U	0.092 U	ND	0.092 U	0.092 U	ND	0.092 U	NA
Chloroform	µg/m <sup>3</sup>	0.234	0.2	0.137	0.190	0.22	0.166	0.193	0.107	0.99
cis-1,2-Dichloroethene	µg/m <sup>3</sup>	0.079 U	0.079 U	0.079 U	ND	0.079 U	0.079 U	ND	0.079 U	NA
Ethylbenzene	µg/m <sup>3</sup>	0.478	0.456	0.195	0.376	0.087 U	0.087 U	ND	0.13	NA
Isopropylbenzene	µg/m <sup>3</sup>	2.46 U	2.46 U	2.46 U	ND	2.46 U	2.46 U	ND	2.46 U	NA
Methylene Chloride	µg/m <sup>3</sup>	2.17 U	1.78 U	3.35 U	ND	3.02 U	1.74 U	ND	2.76 U	NA
Methyl tert-butyl ether	µg/m <sup>3</sup>	0.072 U	0.072 U	0.072 U	ND	0.072 U	0.072 U	ND	0.072 U	NA
Naphthalene	µg/m <sup>3</sup>	0.162 J	0.189 J	0.136 J	0.162	0.262 UJ	0.262 UJ	ND	0.304 J	NA
Tetrachloroethene	µg/m <sup>3</sup>	0.136 U	0.136 U	0.136 U	ND	73.9	145	109	0.136 U	NA
Toluene	µg/m <sup>3</sup>	2.32	1.86	1.2	1.79	0.686 U	0.188 U	ND	1.27	NA
trans-1,2-Dichloroethene	µg/m <sup>3</sup>	0.079 U	0.079 U	0.079 U	ND	0.079 U	0.079 U	ND	0.079 U	NA
trans-1,3-Dichloropropene	µg/m <sup>3</sup>	0.091 U	0.091 U	0.091 U	ND	0.091 U	0.091 U	ND	0.091 U	NA
Trichloroethene	µg/m <sup>3</sup>	0.107 U	0.107 U	0.107 U	ND	0.107 U	0.107 U	ND	0.107 U	NA
Vinyl Chloride	µg/m <sup>3</sup>	0.051 U	0.051 U	0.051 U	ND	0.051 U	0.051 U	ND	0.051 U	NA
Xylenes (total)	µg/m <sup>3</sup>	0.96	0.947	0.617	0.841	0.386	0.261 U	<b>0.386</b>	0.491	2.18

**Notes:**

(a) Attenuation Factor calculated as the ratio of the average detected indoor air to average detected sub-slab soil vapor concentration

U - The compound was analyzed for but not detected. The associated value is the compound quantitation limit

µg/m<sup>3</sup> - Micrograms per cubic meter

IA - Indoor air sample

OA - Ambient air sample

SS - Sub-slab soil vapor sample

NA - Not applicable

ND - Not detected

**Bold** - Value given is detected concentration only, as compound was detected in one sample only

**Table 3. Exposure Assumptions for the Estimation of Risks from Inhalation of Volatile Constituents in Indoor Air for a Resident**

Parameter	Units	Resident – Short Term			Resident – Long Term		
		Value	Source	Comment	Value	Source	Comment
Exposure Time	hours/day	24	(a)		24	(a)	
Exposure Frequency	days/year	350	(a)		350	(a)	
Exposure Duration	years	5	(b)		30	(a)	
Averaging Time – Cancer	hours	613200	(a)		613200	(a)	
Averaging Time – Non-Cancer	hours	262800	(a)		262800	(a)	

**Notes:**

- (a) USEPA 2009
- (b) MADEP 2008a

**Table 4. Estimated Risks to a Resident from Short Term Exposure to Volatile Constituents in Indoor Air via Inhalation**

Parameter	Definition	Units	Value
ET	Indoor Air Exposure Time	hours/day	24
EF	Indoor Air Exposure Frequency	days/yr	350
ED	Indoor Air Exposure Duration	years	5
ATc	Indoor Air Averaging Time - Cancer	hours	613200
ATn	Indoor Air Averaging Time - Non-Cancer	hours	43800
CF	Conversion Factor	ug/mg	1000

Compound	EPC (a) Indoor Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	ADE-c mg/m3	ADE-nc mg/m3	Cancer Risk Indoor Air (unitless)	HI Indoor Air (unitless)	% of Total Cancer Risk (unitless)	% of Total Noncancer HI (unitless)
1,1,1-Trichloroethane	ND	5	NA	ND	ND	ND	ND	NA	NA
1,1,2-Trichloroethane	ND	NA	0.000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethane	ND	NA	0.0000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,2,4-Trimethylbenzene	2.30E-04	0.007	NA	NA	2.20E-04	NA	0.03	NA	29%
1,2-Dibromoethane	ND	0.009	0.0006	ND	ND	ND	ND	NA	NA
1,2-Dichloroethane	2.75E-04	2.4	0.000026	1.88E-05	2.64E-04	5E-07	0.0001	31%	0.1%
1,2-Dichloropropane	ND	0.004	0.00001	ND	ND	ND	ND	NA	NA
1,3-Butadiene	ND	0.002	0.00003	ND	ND	ND	ND	NA	NA
1,3-Dichlorobenzene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,4-Dichlorobenzene	ND	0.8	0.000011	ND	ND	ND	ND	NA	NA
Benzene	3.13E-04	0.03	0.0000078	2.14E-05	3.00E-04	2E-07	0.01	11%	9%
Bromodichloromethane	ND	NA	0.000037	ND	ND	ND	ND	NA	NA
Bromoform	ND	NA	0.0000011	ND	ND	ND	ND	NA	NA
Carbon tetrachloride	4.48E-04	0.1	0.000006	3.07E-05	4.30E-04	2E-07	0.004	12%	4%
Chlorobenzene	ND	0.05	NA	ND	ND	ND	ND	NA	NA
Chloroform	1.90E-04	0.098	0.000023	1.30E-05	1.83E-04	3E-07	0.002	19%	2%
cis-1,2-Dichloroethene	ND	0.035	NA	ND	ND	ND	ND	NA	NA
Ethylbenzene	3.76E-04	1	0.0000025	2.58E-05	3.61E-04	6E-08	0.0004	4%	0.3%
Isopropylbenzene	ND	0.4	NA	ND	ND	ND	ND	NA	NA
Methylene chloride	ND	1	0.00000047	ND	ND	ND	ND	NA	NA
Methyl tert butyl ether	ND	3	0.00000026	ND	ND	ND	ND	NA	NA
Naphthalene	1.62E-04	0.003	0.000034	1.11E-05	1.56E-04	4E-07	0.05	24%	48%
Tetrachloroethene	ND	0.27	0.0000059	ND	ND	ND	ND	NA	NA
Toluene	1.79E-03	5	NA	NA	1.72E-03	NA	0.0003	NA	0.3%
trans-1,2-Dichloroethene	ND	0.06	NA	ND	ND	ND	ND	NA	NA
trans-1,3-Dichloropropene	ND	0.02	0.000004	ND	ND	ND	ND	NA	NA
Trichloroethene	ND	NA	0.000002	ND	ND	ND	ND	NA	NA
Vinyl chloride	ND	0.1	0.0000044	ND	ND	ND	ND	NA	NA
Xylenes	8.41E-04	0.1	NA	NA	8.07E-04	NA	0.008	NA	7%
Total						2E-06	0.1	100%	100%

$$ADE = \frac{EPC_{air} \times ET \times EF \times ED}{AT}$$

$$HI_{inh} = \frac{ADE}{RfC}$$

$$Risk = ADE \times URF \times CF$$

**Notes:**

(a) EPC calculated as average of detected concentrations and one-half indoor air detection limit for non-detects.

EC = exposure concentration

EPC - exposure point concentration

RfC - reference concentration

URF - unit risk factor

ADE-c - average daily exposure (cancer)

ADE-nc - average daily exposure (noncancer)

HI - noncancer hazard index

ug/mg3 - microgram per cubic milligram

NA - Not available

ND - Not detected

mg/m3 - milligram per cubic meter

**Table 5. Estimated Risks to a Resident from Long Term Exposure to Volatile Constituents in Indoor Air via Inhalation**

Parameter	Definition	Units	Value
ET	Indoor Air Exposure Time	hours/day	24
EF	Indoor Air Exposure Frequency	days/yr	350
ED	Indoor Air Exposure Duration	years	30
ATc	Indoor Air Averaging Time - Cancer	hours	613200
ATn	Indoor Air Averaging Time - Non-Cancer	hours	262800
CF	Conversion Factor	ug/mg	1000

Compound	EPC (a) Indoor Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	ADE-c mg/m3	ADE-nc mg/m3	Cancer Risk Indoor Air (unitless)	HI Indoor Air (unitless)	% of Total Cancer Risk (unitless)	% of Total Noncancer HI (unitless)
1,1,1-Trichloroethane	ND	5	NA	ND	ND	ND	ND	NA	NA
1,1,2-Trichloroethane	ND	NA	0.000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethane	ND	NA	0.0000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,2,4-Trimethylbenzene	2.30E-04	0.007	NA	NA	2.20E-04	NA	0.03	NA	29%
1,2-Dibromoethane	ND	0.009	0.0006	ND	ND	ND	ND	NA	NA
1,2-Dichloroethane	2.75E-04	2.4	0.000026	1.13E-04	2.64E-04	3E-06	0.0001	31%	0.1%
1,2-Dichloropropane	ND	0.004	0.00001	ND	ND	ND	ND	NA	NA
1,3-Butadiene	ND	0.002	0.00003	ND	ND	ND	ND	NA	NA
1,3-Dichlorobenzene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,4-Dichlorobenzene	ND	0.8	0.000011	ND	ND	ND	ND	NA	NA
Benzene	3.13E-04	0.03	0.0000078	1.29E-04	3.00E-04	1E-06	0.01	11%	9%
Bromodichloromethane	ND	NA	0.000037	ND	ND	ND	ND	NA	NA
Bromoform	ND	NA	0.0000011	ND	ND	ND	ND	NA	NA
Carbon tetrachloride	4.48E-04	0.1	0.000006	1.84E-04	4.30E-04	1E-06	0.004	12%	4%
Chlorobenzene	ND	0.05	NA	ND	ND	ND	ND	NA	NA
Chloroform	1.90E-04	0.098	0.000023	7.82E-05	1.83E-04	2E-06	0.002	19%	2%
cis-1,2-Dichloroethene	ND	0.035	NA	ND	ND	ND	ND	NA	NA
Ethylbenzene	3.76E-04	1	0.0000025	1.55E-04	3.61E-04	4E-07	0.0004	4%	0.3%
Isopropylbenzene	ND	0.4	NA	ND	ND	ND	ND	NA	NA
Methylene chloride	ND	1	0.00000047	ND	ND	ND	ND	NA	NA
Methyl tert butyl ether	ND	3	0.00000026	ND	ND	ND	ND	NA	NA
Naphthalene	1.62E-04	0.003	0.000034	6.67E-05	1.56E-04	2E-06	0.05	24%	48%
Tetrachloroethene	ND	0.27	0.0000059	ND	ND	ND	ND	NA	NA
Toluene	1.79E-03	5	NA	NA	1.72E-03	NA	0.0003	NA	0.3%
trans-1,2-Dichloroethene	ND	0.06	NA	ND	ND	ND	ND	NA	NA
trans-1,3-Dichloropropene	ND	0.02	0.000004	ND	ND	ND	ND	NA	NA
Trichloroethene	ND	NA	0.000002	ND	ND	ND	ND	NA	NA
Vinyl chloride	ND	0.1	0.0000044	ND	ND	ND	ND	NA	NA
Xylenes	8.41E-04	0.1	NA	NA	8.07E-04	NA	0.008	NA	7%
Total						1E-05	0.1	100%	100%

$$ADE = \frac{EPC_{air} \times ET \times EF \times ED}{AT}$$

$$HI_{inh} = \frac{ADE}{RfC}$$

$$Risk = ADE \times URF \times CF$$

**Notes:**

(a) EPC calculated as average of detected concentrations and one-half indoor air detection limit for non-detects.

EC = exposure concentration

EPC - exposure point concentration

RfC - reference concentration

URF - unit risk factor

ADE-c - average daily exposure (cancer)

ADE-nc - average daily exposure (noncancer)

HI - noncancer hazard index

ug/mg3 - microgram per cubic milligram

NA - Not available

ND - Not detected

mg/m3 - milligram per cubic meter



**Table 6. Estimated Risks to a Resident from Short Term Exposure to Volatile Constituents in Indoor Air via Inhalation - Combined Results**

Parameter	Definition	Units	Value
ET	Indoor Air Exposure Time	hours/day	24
EF	Indoor Air Exposure Frequency	days/yr	350
ED	Indoor Air Exposure Duration	years	5
ATc	Indoor Air Averaging Time - Cancer	hours	613200
ATn	Indoor Air Averaging Time - Non-Cancer	hours	43800
CF	Conversion Factor	ug/mg	1000

Compound	EPC (a) Indoor Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	ADE-c mg/m3	ADE-nc mg/m3	Cancer Risk Indoor Air (unitless)	HI Indoor Air (unitless)	% of Total Cancer Risk (unitless)	% of Total Noncancer HI (unitless)
1,1,1-Trichloroethane	ND	5	NA	ND	ND	ND	ND	NA	NA
1,1,2-Trichloroethane	ND	NA	0.000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethane	ND	NA	0.0000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,2,4-Trimethylbenzene	2.92E-04	0.007	NA	NA	2.80E-04	NA	0.04	NA	23%
1,2-Dibromoethane	ND	0.009	0.0006	ND	ND	ND	ND	NA	NA
1,2-Dichloroethane	2.84E-04	2.4	0.000026	1.94E-05	2.72E-04	5E-07	0.0001	25%	0.06%
1,2-Dichloropropane	ND	0.004	0.00001	ND	ND	ND	ND	NA	NA
1,3-Butadiene	1.18E-04	0.002	0.00003	8.05E-06	1.13E-04	2E-07	0.06	12%	32%
1,3-Dichlorobenzene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,4-Dichlorobenzene	ND	0.8	0.000011	ND	ND	ND	ND	NA	NA
Benzene	6.29E-04	0.03	0.0000078	4.31E-05	6.03E-04	3E-07	0.02	16%	11%
Bromodichloromethane	ND	NA	0.000037	ND	ND	ND	ND	NA	NA
Bromoform	ND	NA	0.0000011	ND	ND	ND	ND	NA	NA
Carbon tetrachloride	3.93E-04	0.1	0.000006	2.69E-05	3.77E-04	2E-07	0.004	8%	2%
Chlorobenzene	ND	0.05	NA	ND	ND	ND	ND	NA	NA
Chloroform	2.21E-04	0.098	0.000023	1.51E-05	2.11E-04	3E-07	0.002	17%	1%
cis-1,2-Dichloroethene	ND	0.035	NA	ND	ND	ND	ND	NA	NA
Ethylbenzene	4.87E-04	1	0.0000025	3.33E-05	4.67E-04	8E-08	0.0005	4%	0.3%
Isopropylbenzene	ND	0.4	NA	ND	ND	ND	ND	NA	NA
Methylene chloride	ND	1	0.00000047	ND	ND	ND	ND	NA	NA
Methyl tert butyl ether	ND	3	0.00000026	ND	ND	ND	ND	NA	NA
Naphthalene	1.27E-04	0.003	0.000034	8.73E-06	1.22E-04	3E-07	0.04	14%	23%
Tetrachloroethene	2.05E-04	0.27	0.0000059	1.40E-05	1.96E-04	8E-08	0.0007	4%	0.4%
Toluene	2.30E-03	5	NA	NA	2.20E-03	NA	0.0004	NA	0.2%
trans-1,2-Dichloroethene	ND	0.06	NA	ND	ND	ND	ND	NA	NA
trans-1,3-Dichloropropene	ND	0.02	0.000004	ND	ND	ND	ND	NA	NA
Trichloroethene	ND	NA	0.000002	ND	ND	ND	ND	NA	NA
Vinyl chloride	ND	0.1	0.0000044	ND	ND	ND	ND	NA	NA
Xylenes	1.31E-03	0.1	NA	NA	1.26E-03	NA	0.01	NA	7%
Total						2E-06	0.2	100%	100%

$$ADE = \frac{EPC_{air} \times ET \times EF \times ED}{AT}$$

$$HI_{inh} = \frac{ADE}{RfC}$$

$$Risk = ADE \times URF \times CF$$

**Notes:**

(a) EPC calculated as average of detected concentrations and one-half indoor air detection limit for non-detects.

EC = exposure concentration

EPC - exposure point concentration

RfC - reference concentration

URF - unit risk factor

ADE-c - average daily exposure (cancer)

ADE-nc - average daily exposure (noncancer)

HI - noncancer hazard index

ug/mg3 - microgram per cubic milligram

NA - Not available

ND - Not detected

mg/m3 - milligram per cubic meter

**Table 7. Estimated Risks to a Resident from Long Term Exposure to Volatile Constituents in Indoor Air via Inhalation - Combined Results**

Parameter	Definition	Units	Value
ET	Indoor Air Exposure Time	hours/day	24
EF	Indoor Air Exposure Frequency	days/yr	350
ED	Indoor Air Exposure Duration	years	30
ATc	Indoor Air Averaging Time - Cancer	hours	613200
ATn	Indoor Air Averaging Time - Non-Cancer	hours	262800
CF	Conversion Factor	ug/mg	1000

Compound	EPC (a) Indoor Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	ADE-c mg/m3	ADE-nc mg/m3	Cancer Risk Indoor Air (unitless)	HI Indoor Air (unitless)	% of Total Cancer Risk (unitless)	% of Total Noncancer HI (unitless)
1,1,1-Trichloroethane	ND	5	NA	ND	ND	ND	ND	NA	NA
1,1,2-Trichloroethane	ND	NA	0.000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethane	ND	NA	0.0000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,2,4-Trimethylbenzene	2.92E-04	0.007	NA	NA	2.80E-04	NA	0.04	NA	23%
1,2-Dibromoethane	ND	0.009	0.0006	ND	ND	ND	ND	NA	NA
1,2-Dichloroethane	2.84E-04	2.4	0.000026	1.17E-04	2.72E-04	3E-06	0.0001	25%	0.06%
1,2-Dichloropropane	ND	0.004	0.00001	ND	ND	ND	ND	NA	NA
1,3-Butadiene	1.18E-04	0.002	0.00003	4.83E-05	1.13E-04	1E-06	0.06	12%	32%
1,3-Dichlorobenzene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,4-Dichlorobenzene	ND	0.8	0.000011	ND	ND	ND	ND	NA	NA
Benzene	6.29E-04	0.03	0.0000078	2.58E-04	6.03E-04	2E-06	0.02	16%	11%
Bromodichloromethane	ND	NA	0.000037	ND	ND	ND	ND	NA	NA
Bromoform	ND	NA	0.0000011	ND	ND	ND	ND	NA	NA
Carbon tetrachloride	3.93E-04	0.1	0.000006	1.61E-04	3.77E-04	1E-06	0.004	8%	2%
Chlorobenzene	ND	0.05	NA	ND	ND	ND	ND	NA	NA
Chloroform	2.21E-04	0.098	0.000023	9.06E-05	2.11E-04	2E-06	0.002	17%	1%
cis-1,2-Dichloroethene	ND	0.035	NA	ND	ND	ND	ND	NA	NA
Ethylbenzene	4.87E-04	1	0.0000025	2.00E-04	4.67E-04	5E-07	0.0005	4%	0.3%
Isopropylbenzene	ND	0.4	NA	ND	ND	ND	ND	NA	NA
Methylene chloride	ND	1	0.00000047	ND	ND	ND	ND	NA	NA
Methyl tert butyl ether	ND	3	0.00000026	ND	ND	ND	ND	NA	NA
Naphthalene	1.27E-04	0.003	0.000034	5.24E-05	1.22E-04	2E-06	0.04	14%	23%
Tetrachloroethene	2.05E-04	0.27	0.0000059	8.40E-05	1.96E-04	5E-07	0.0007	4%	0.4%
Toluene	2.30E-03	5	NA	NA	2.20E-03	NA	0.0004	NA	0.2%
trans-1,2-Dichloroethene	ND	0.06	NA	ND	ND	ND	ND	NA	NA
trans-1,3-Dichloropropene	ND	0.02	0.000004	ND	ND	ND	ND	NA	NA
Trichloroethene	ND	NA	0.000002	ND	ND	ND	ND	NA	NA
Vinyl chloride	ND	0.1	0.0000044	ND	ND	ND	ND	NA	NA
Xylenes	1.31E-03	0.1	NA	NA	1.26E-03	NA	0.01	NA	7%
Total						1E-05	0.2	100%	100%

$$ADE = \frac{EPC_{air} \times ET \times EF \times ED}{AT}$$

$$HI_{inh} = \frac{ADE}{RfC}$$

$$Risk = ADE \times URF \times CF$$

**Notes:**

(a) EPC calculated as average of detected concentrations and one-half indoor air detection limit for non-detects.

EC = exposure concentration

EPC - exposure point concentration

RfC - reference concentration

URF - unit risk factor

ADE-c - average daily exposure (cancer)

ADE-nc - average daily exposure (noncancer)

HI - noncancer hazard index

ug/mg3 - microgram per cubic milligram

NA - Not available

ND - Not detected

mg/m3 - milligram per cubic meter



## **Attachment A**

Risk Tables

**Table A1. Estimated Risks to a Resident from Short Term Exposure to Volatile Constituents in Indoor Air via Inhalation - Sample IA-1 26/05/05 North**

Parameter	Definition	Units	Value
ET	Indoor Air Exposure Time	hours/day	24
EF	Indoor Air Exposure Frequency	days/yr	350
ED	Indoor Air Exposure Duration	years	5
ATc	Indoor Air Averaging Time - Cancer	hours	613200
ATn	Indoor Air Averaging Time - Non-Cancer	hours	43800
CF	Conversion Factor	ug/mg	1000

Compound	EPC (a) Indoor Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	ADE-c mg/m3	ADE-nc mg/m3	Cancer Risk Indoor Air (unitless)	HI Indoor Air (unitless)	% of Total Cancer Risk (unitless)	% of Total Noncancer HI (unitless)
1,1,1-Trichloroethane	ND	5	NA	ND	ND	ND	ND	NA	NA
1,1,2-Trichloroethane	ND	NA	0.000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethane	ND	NA	0.0000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,2,4-Trimethylbenzene	2.56E-04	0.007	NA	NA	2.45E-04	NA	0.04	NA	31%
1,2-Dibromoethane	ND	0.009	0.0006	ND	ND	ND	ND	NA	NA
1,2-Dichloroethane	2.02E-04	2.4	0.000026	1.38E-05	1.94E-04	4E-07	0.00008	24%	0.07%
1,2-Dichloropropane	ND	0.004	0.00001	ND	ND	ND	ND	NA	NA
1,3-Butadiene	ND	0.002	0.00003	ND	ND	ND	ND	NA	NA
1,3-Dichlorobenzene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,4-Dichlorobenzene	ND	0.8	0.000011	ND	ND	ND	ND	NA	NA
Benzene	3.16E-04	0.03	0.0000078	2.16E-05	3.03E-04	2E-07	0.01	11%	9%
Bromodichloromethane	ND	NA	0.000037	ND	ND	ND	ND	NA	NA
Bromoform	ND	NA	0.0000011	ND	ND	ND	ND	NA	NA
Carbon tetrachloride	4.21E-04	0.1	0.000006	2.88E-05	4.04E-04	2E-07	0.004	11%	4%
Chlorobenzene	ND	0.05	NA	ND	ND	ND	ND	NA	NA
Chloroform	2.34E-04	0.098	0.000023	1.60E-05	2.24E-04	4E-07	0.002	24%	2%
cis-1,2-Dichloroethene	ND	0.035	NA	ND	ND	ND	ND	NA	NA
Ethylbenzene	4.78E-04	1	0.0000025	3.27E-05	4.58E-04	8E-08	0.0005	5%	0.4%
Isopropylbenzene	ND	0.4	NA	ND	ND	ND	ND	NA	NA
Methylene chloride	ND	1	0.00000047	ND	ND	ND	ND	NA	NA
Methyl tert butyl ether	ND	3	0.00000026	ND	ND	ND	ND	NA	NA
Naphthalene	1.62E-04	0.003	0.000034	1.11E-05	1.55E-04	4E-07	0.05	25%	46%
Tetrachloroethene	ND	0.27	0.0000059	ND	ND	ND	ND	NA	NA
Toluene	2.32E-03	5	NA	NA	2.22E-03	NA	0.0004	NA	0.4%
trans-1,2-Dichloroethene	ND	0.06	NA	ND	ND	ND	ND	NA	NA
trans-1,3-Dichloropropene	ND	0.02	0.000004	ND	ND	ND	ND	NA	NA
Trichloroethene	ND	NA	0.000002	ND	ND	ND	ND	NA	NA
Vinyl chloride	ND	0.1	0.0000044	ND	ND	ND	ND	NA	NA
Xylenes	9.60E-04	0.1	NA	NA	9.21E-04	NA	0.009	NA	8%
Total						2E-06	0.1	100%	100%

$$ADE = \frac{EPC_{air} \times ET \times EF \times ED}{AT}$$

$$HI_{inh} = \frac{ADE}{RfC}$$

$$Risk = ADE \times URF \times CF$$

**Notes:**

(a) EPC calculated as average of detected concentrations and one-half indoor air detection limit for non-detects.

EC = exposure concentration

EPC = exposure point concentration

RfC = reference concentration

URF = unit risk factor

ADE-c = average daily exposure (cancer)

ADE-nc = average daily exposure (noncancer)

HI = noncancer hazard index

ug/mg3 = microgram per cubic milligram

NA = Not available

ND = Not detected

mg/m3 = milligram per cubic meter

**Table A2. Estimated Risks to a Resident from Long Term Exposure to Volatile Constituents in Indoor Air via Inhalation - Sample IA-1 26/05/05 North**

Parameter	Definition	Units	Value
ET	Indoor Air Exposure Time	hours/day	24
EF	Indoor Air Exposure Frequency	days/yr	350
ED	Indoor Air Exposure Duration	years	30
ATc	Indoor Air Averaging Time - Cancer	hours	613200
ATn	Indoor Air Averaging Time - Non-Cancer	hours	262800
CF	Conversion Factor	ug/mg	1000

Compound	EPC (a) Indoor Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	ADE-c mg/m3	ADE-nc mg/m3	Cancer Risk Indoor Air (unitless)	HI Indoor Air (unitless)	% of Total Cancer Risk (unitless)	% of Total Noncancer HI (unitless)
1,1,1-Trichloroethane	ND	5	NA	ND	ND	ND	ND	NA	NA
1,1,2-Trichloroethane	ND	NA	0.000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethane	ND	NA	0.0000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,2,4-Trimethylbenzene	2.56E-04	0.007	NA	NA	2.45E-04	NA	0.04	NA	31%
1,2-Dibromoethane	ND	0.009	0.0006	ND	ND	ND	ND	NA	NA
1,2-Dichloroethane	2.02E-04	2.4	0.000026	8.30E-05	1.94E-04	2E-06	0.00008	24%	0.07%
1,2-Dichloropropane	ND	0.004	0.00001	ND	ND	ND	ND	NA	NA
1,3-Butadiene	ND	0.002	0.00003	ND	ND	ND	ND	NA	NA
1,3-Dichlorobenzene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,4-Dichlorobenzene	ND	0.8	0.000011	ND	ND	ND	ND	NA	NA
Benzene	3.16E-04	0.03	0.0000078	1.30E-04	3.03E-04	1E-06	0.01	11%	9%
Bromodichloromethane	ND	NA	0.000037	ND	ND	ND	ND	NA	NA
Bromoform	ND	NA	0.0000011	ND	ND	ND	ND	NA	NA
Carbon tetrachloride	4.21E-04	0.1	0.000006	1.73E-04	4.04E-04	1E-06	0.004	11%	4%
Chlorobenzene	ND	0.05	NA	ND	ND	ND	ND	NA	NA
Chloroform	2.34E-04	0.098	0.000023	9.62E-05	2.24E-04	2E-06	0.002	24%	2%
cis-1,2-Dichloroethene	ND	0.035	NA	ND	ND	ND	ND	NA	NA
Ethylbenzene	4.78E-04	1	0.0000025	1.96E-04	4.58E-04	5E-07	0.0005	5%	0.4%
Isopropylbenzene	ND	0.4	NA	ND	ND	ND	ND	NA	NA
Methylene chloride	ND	1	0.00000047	ND	ND	ND	ND	NA	NA
Methyl tert butyl ether	ND	3	0.00000026	ND	ND	ND	ND	NA	NA
Naphthalene	1.62E-04	0.003	0.000034	6.66E-05	1.55E-04	2E-06	0.05	25%	46%
Tetrachloroethene	ND	0.27	0.0000059	ND	ND	ND	ND	NA	NA
Toluene	2.32E-03	5	NA	NA	2.22E-03	NA	0.0004	NA	0.4%
trans-1,2-Dichloroethene	ND	0.06	NA	ND	ND	ND	ND	NA	NA
trans-1,3-Dichloropropene	ND	0.02	0.000004	ND	ND	ND	ND	NA	NA
Trichloroethene	ND	NA	0.000002	ND	ND	ND	ND	NA	NA
Vinyl chloride	ND	0.1	0.0000044	ND	ND	ND	ND	NA	NA
Xylenes	9.60E-04	0.1	NA	NA	9.21E-04	NA	0.009	NA	8%
Total						9E-06	0.1	100%	100%

$$ADE = \frac{EPC_{air} \times ET \times EF \times ED}{AT}$$

$$HI_{inh} = \frac{ADE}{RfC}$$

$$Risk = ADE \times URF \times CF$$

**Notes:**

(a) EPC calculated as average of detected concentrations and one-half indoor air detection limit for non-detects.

EC = exposure concentration

EPC = exposure point concentration

RfC = reference concentration

URF = unit risk factor

ADE-c = average daily exposure (cancer)

ADE-nc = average daily exposure (noncancer)

HI = noncancer hazard index

ug/mg3 = microgram per cubic milligram

NA = Not available

ND = Not detected

mg/m3 = milligram per cubic meter

**Table A3. Estimated Risks to a Resident from Short Term Exposure to Volatile Constituents in Indoor Air via Inhalation - Sample IA-2 26/05/05 North**

Parameter	Definition	Units	Value
ET	Indoor Air Exposure Time	hours/day	24
EF	Indoor Air Exposure Frequency	days/yr	350
ED	Indoor Air Exposure Duration	years	5
ATc	Indoor Air Averaging Time - Cancer	hours	613200
ATn	Indoor Air Averaging Time - Non-Cancer	hours	43800
CF	Conversion Factor	ug/mg	1000

Compound	EPC (a) Indoor Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	ADE-c mg/m3	ADE-nc mg/m3	Cancer Risk Indoor Air (unitless)	HI Indoor Air (unitless)	% of Total Cancer Risk (unitless)	% of Total Noncancer HI (unitless)
1,1,1-Trichloroethane	ND	5	NA	ND	ND	ND	ND	NA	NA
1,1,2-Trichloroethane	ND	NA	0.000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethane	ND	NA	0.0000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,2,4-Trimethylbenzene	2.56E-04	0.007	NA	NA	2.45E-04	NA	0.04	NA	29%
1,2-Dibromoethane	ND	0.009	0.0006	ND	ND	ND	ND	NA	NA
1,2-Dichloroethane	1.62E-04	2.4	0.000026	1.11E-05	1.55E-04	3E-07	0.00006	19%	0.05%
1,2-Dichloropropane	ND	0.004	0.00001	ND	ND	ND	ND	NA	NA
1,3-Butadiene	ND	0.002	0.00003	ND	ND	ND	ND	NA	NA
1,3-Dichlorobenzene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,4-Dichlorobenzene	ND	0.8	0.000011	ND	ND	ND	ND	NA	NA
Benzene	3.45E-04	0.03	0.0000078	2.36E-05	3.31E-04	2E-07	0.01	12%	9%
Bromodichloromethane	ND	NA	0.000037	ND	ND	ND	ND	NA	NA
Bromoform	ND	NA	0.0000011	ND	ND	ND	ND	NA	NA
Carbon tetrachloride	4.65E-04	0.1	0.000006	3.18E-05	4.46E-04	2E-07	0.004	13%	4%
Chlorobenzene	ND	0.05	NA	ND	ND	ND	ND	NA	NA
Chloroform	2.00E-04	0.098	0.000023	1.37E-05	1.92E-04	3E-07	0.002	21%	2%
cis-1,2-Dichloroethene	ND	0.035	NA	ND	ND	ND	ND	NA	NA
Ethylbenzene	4.56E-04	1	0.0000025	3.12E-05	4.37E-04	8E-08	0.0004	5%	0.4%
Isopropylbenzene	ND	0.4	NA	ND	ND	ND	ND	NA	NA
Methylene chloride	ND	1	0.00000047	ND	ND	ND	ND	NA	NA
Methyl tert butyl ether	ND	3	0.00000026	ND	ND	ND	ND	NA	NA
Naphthalene	1.89E-04	0.003	0.000034	1.29E-05	1.81E-04	4E-07	0.06	29%	49%
Tetrachloroethene	ND	0.27	0.0000059	ND	ND	ND	ND	NA	NA
Toluene	1.86E-03	5	NA	NA	1.78E-03	NA	0.0004	NA	0.3%
trans-1,2-Dichloroethene	ND	0.06	NA	ND	ND	ND	ND	NA	NA
trans-1,3-Dichloropropene	ND	0.02	0.000004	ND	ND	ND	ND	NA	NA
Trichloroethene	ND	NA	0.000002	ND	ND	ND	ND	NA	NA
Vinyl chloride	ND	0.1	0.0000044	ND	ND	ND	ND	NA	NA
Xylenes	9.47E-04	0.1	NA	NA	9.08E-04	NA	0.009	NA	7%
Total						1E-06	0.1	100%	100%

$$ADE = \frac{EPC_{air} \times ET \times EF \times ED}{AT}$$

$$HI_{inh} = \frac{ADE}{RfC}$$

$$Risk = ADE \times URF \times CF$$

**Notes:**

(a) EPC calculated as average of detected concentrations and one-half indoor air detection limit for non-detects.

EC = exposure concentration

EPC = exposure point concentration

RfC = reference concentration

URF = unit risk factor

ADE-c = average daily exposure (cancer)

ADE-nc = average daily exposure (noncancer)

HI = noncancer hazard index

ug/mg3 = microgram per cubic milligram

NA = Not available

ND = Not detected

mg/m3 = milligram per cubic meter

**Table A4. Estimated Risks to a Resident from Long Term Exposure to Volatile Constituents in Indoor Air via Inhalation - Sample IA-2 26/05/05 North**

Parameter	Definition	Units	Value
ET	Indoor Air Exposure Time	hours/day	24
EF	Indoor Air Exposure Frequency	days/yr	350
ED	Indoor Air Exposure Duration	years	30
ATc	Indoor Air Averaging Time - Cancer	hours	613200
ATn	Indoor Air Averaging Time - Non-Cancer	hours	262800
CF	Conversion Factor	ug/mg	1000

Compound	EPC (a) Indoor Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	ADE-c mg/m3	ADE-nc mg/m3	Cancer Risk Indoor Air (unitless)	HI Indoor Air (unitless)	% of Total Cancer Risk (unitless)	% of Total Noncancer HI (unitless)
1,1,1-Trichloroethane	ND	5	NA	ND	ND	ND	ND	NA	NA
1,1,2-Trichloroethane	ND	NA	0.000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethane	ND	NA	0.0000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,2,4-Trimethylbenzene	2.56E-04	0.007	NA	NA	2.45E-04	NA	0.04	NA	29%
1,2-Dibromoethane	ND	0.009	0.0006	ND	ND	ND	ND	NA	NA
1,2-Dichloroethane	1.62E-04	2.4	0.000026	6.66E-05	1.55E-04	2E-06	0.00006	19%	0.05%
1,2-Dichloropropane	ND	0.004	0.00001	ND	ND	ND	ND	NA	NA
1,3-Butadiene	ND	0.002	0.00003	ND	ND	ND	ND	NA	NA
1,3-Dichlorobenzene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,4-Dichlorobenzene	ND	0.8	0.000011	ND	ND	ND	ND	NA	NA
Benzene	3.45E-04	0.03	0.0000078	1.42E-04	3.31E-04	1E-06	0.01	12%	9%
Bromodichloromethane	ND	NA	0.000037	ND	ND	ND	ND	NA	NA
Bromoform	ND	NA	0.0000011	ND	ND	ND	ND	NA	NA
Carbon tetrachloride	4.65E-04	0.1	0.000006	1.91E-04	4.46E-04	1E-06	0.004	13%	4%
Chlorobenzene	ND	0.05	NA	ND	ND	ND	ND	NA	NA
Chloroform	2.00E-04	0.098	0.000023	8.22E-05	1.92E-04	2E-06	0.002	21%	2%
cis-1,2-Dichloroethene	ND	0.035	NA	ND	ND	ND	ND	NA	NA
Ethylbenzene	4.56E-04	1	0.0000025	1.87E-04	4.37E-04	5E-07	0.0004	5%	0.4%
Isopropylbenzene	ND	0.4	NA	ND	ND	ND	ND	NA	NA
Methylene chloride	ND	1	0.00000047	ND	ND	ND	ND	NA	NA
Methyl tert butyl ether	ND	3	0.00000026	ND	ND	ND	ND	NA	NA
Naphthalene	1.89E-04	0.003	0.000034	7.77E-05	1.81E-04	3E-06	0.06	29%	49%
Tetrachloroethene	ND	0.27	0.0000059	ND	ND	ND	ND	NA	NA
Toluene	1.86E-03	5	NA	NA	1.78E-03	NA	0.0004	NA	0.3%
trans-1,2-Dichloroethene	ND	0.06	NA	ND	ND	ND	ND	NA	NA
trans-1,3-Dichloropropene	ND	0.02	0.000004	ND	ND	ND	ND	NA	NA
Trichloroethene	ND	NA	0.000002	ND	ND	ND	ND	NA	NA
Vinyl chloride	ND	0.1	0.0000044	ND	ND	ND	ND	NA	NA
Xylenes	9.47E-04	0.1	NA	NA	9.08E-04	NA	0.009	NA	7%
Total						9E-06	0.1	100%	100%

$$ADE = \frac{EPC_{air} \times ET \times EF \times ED}{AT}$$

$$HI_{inh} = \frac{ADE}{RfC}$$

$$Risk = ADE \times URF \times CF$$

**Notes:**

(a) EPC calculated as average of detected concentrations and one-half indoor air detection limit for non-detects.

EC = exposure concentration

EPC = exposure point concentration

RfC = reference concentration

URF = unit risk factor

ADE-c = average daily exposure (cancer)

ADE-nc = average daily exposure (noncancer)

HI = noncancer hazard index

ug/mg3 = microgram per cubic milligram

NA = Not available

ND = Not detected

mg/m3 = milligram per cubic meter

**Table A5. Estimated Risks to a Resident from Short Term Exposure to Volatile Constituents in Indoor Air via Inhalation - Sample IA-3 26/05/05 North**

Parameter	Definition	Units	Value
ET	Indoor Air Exposure Time	hours/day	24
EF	Indoor Air Exposure Frequency	days/yr	350
ED	Indoor Air Exposure Duration	years	5
ATc	Indoor Air Averaging Time - Cancer	hours	613200
ATn	Indoor Air Averaging Time - Non-Cancer	hours	43800
CF	Conversion Factor	ug/mg	1000

Compound	EPC (a) Indoor Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	ADE-c mg/m3	ADE-nc mg/m3	Cancer Risk Indoor Air (unitless)	HI Indoor Air (unitless)	% of Total Cancer Risk (unitless)	% of Total Noncancer HI (unitless)
1,1,1-Trichloroethane	ND	5	NA	ND	ND	ND	ND	NA	NA
1,1,2-Trichloroethane	ND	NA	0.000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethane	ND	NA	0.0000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,2,4-Trimethylbenzene	1.77E-04	0.007	NA	NA	1.70E-04	NA	0.02	NA	27%
1,2-Dibromoethane	ND	0.009	0.0006	ND	ND	ND	ND	NA	NA
1,2-Dichloroethane	4.61E-04	2.4	0.000026	3.16E-05	4.42E-04	8E-07	0.0002	48%	0.2%
1,2-Dichloropropane	ND	0.004	0.00001	ND	ND	ND	ND	NA	NA
1,3-Butadiene	ND	0.002	0.00003	ND	ND	ND	ND	NA	NA
1,3-Dichlorobenzene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,4-Dichlorobenzene	ND	0.8	0.000011	ND	ND	ND	ND	NA	NA
Benzene	2.78E-04	0.03	0.0000078	1.90E-05	2.67E-04	1E-07	0.009	9%	10%
Bromodichloromethane	ND	NA	0.000037	ND	ND	ND	ND	NA	NA
Bromoform	ND	NA	0.0000011	ND	ND	ND	ND	NA	NA
Carbon tetrachloride	4.59E-04	0.1	0.000006	3.14E-05	4.40E-04	2E-07	0.004	11%	5%
Chlorobenzene	ND	0.05	NA	ND	ND	ND	ND	NA	NA
Chloroform	1.37E-04	0.098	0.000023	9.38E-06	1.31E-04	2E-07	0.001	13%	2%
cis-1,2-Dichloroethene	ND	0.035	NA	ND	ND	ND	ND	NA	NA
Ethylbenzene	1.95E-04	1	0.0000025	1.34E-05	1.87E-04	3E-08	0.0002	2%	0.2%
Isopropylbenzene	ND	0.4	NA	ND	ND	ND	ND	NA	NA
Methylene chloride	ND	1	0.00000047	ND	ND	ND	ND	NA	NA
Methyl tert butyl ether	ND	3	0.00000026	ND	ND	ND	ND	NA	NA
Naphthalene	1.36E-04	0.003	0.000034	9.32E-06	1.30E-04	3E-07	0.04	18%	49%
Tetrachloroethene	ND	0.27	0.0000059	ND	ND	ND	ND	NA	NA
Toluene	1.20E-03	5	NA	NA	1.15E-03	NA	0.0002	NA	0.3%
trans-1,2-Dichloroethene	ND	0.06	NA	ND	ND	ND	ND	NA	NA
trans-1,3-Dichloropropene	ND	0.02	0.000004	ND	ND	ND	ND	NA	NA
Trichloroethene	ND	NA	0.000002	ND	ND	ND	ND	NA	NA
Vinyl chloride	ND	0.1	0.0000044	ND	ND	ND	ND	NA	NA
Xylenes	6.17E-04	0.1	NA	NA	5.92E-04	NA	0.006	NA	7%
Total						2E-06	0.09	100%	100%

$$ADE = \frac{EPC_{air} \times ET \times EF \times ED}{AT}$$

$$HI_{inh} = \frac{ADE}{RfC}$$

$$Risk = ADE \times URF \times CF$$

**Notes:**

(a) EPC calculated as average of detected concentrations and one-half indoor air detection limit for non-detects.

EC = exposure concentration

EPC = exposure point concentration

RfC = reference concentration

URF = unit risk factor

ADE-c = average daily exposure (cancer)

ADE-nc = average daily exposure (noncancer)

HI = noncancer hazard index

ug/mg3 = microgram per cubic milligram

NA = Not available

ND = Not detected

mg/m3 = milligram per cubic meter



**Table A6. Estimated Risks to a Resident from Long Term Exposure to Volatile Constituents in Indoor Air via Inhalation - Sample IA-3 26/05/05 North**

Parameter	Definition	Units	Value
ET	Indoor Air Exposure Time	hours/day	24
EF	Indoor Air Exposure Frequency	days/yr	350
ED	Indoor Air Exposure Duration	years	30
ATc	Indoor Air Averaging Time - Cancer	hours	613200
ATn	Indoor Air Averaging Time - Non-Cancer	hours	262800
CF	Conversion Factor	ug/mg	1000

Compound	EPC (a) Indoor Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	ADE-c mg/m3	ADE-nc mg/m3	Cancer Risk Indoor Air (unitless)	HI Indoor Air (unitless)	% of Total Cancer Risk (unitless)	% of Total Noncancer HI (unitless)
1,1,1-Trichloroethane	ND	5	NA	ND	ND	ND	ND	NA	NA
1,1,2-Trichloroethane	ND	NA	0.000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethane	ND	NA	0.0000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,2,4-Trimethylbenzene	1.77E-04	0.007	NA	NA	1.70E-04	NA	0.02	NA	27%
1,2-Dibromoethane	ND	0.009	0.0006	ND	ND	ND	ND	NA	NA
1,2-Dichloroethane	4.61E-04	2.4	0.000026	1.89E-04	4.42E-04	5E-06	0.0002	48%	0.2%
1,2-Dichloropropane	ND	0.004	0.00001	ND	ND	ND	ND	NA	NA
1,3-Butadiene	ND	0.002	0.00003	ND	ND	ND	ND	NA	NA
1,3-Dichlorobenzene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,4-Dichlorobenzene	ND	0.8	0.000011	ND	ND	ND	ND	NA	NA
Benzene	2.78E-04	0.03	0.0000078	1.14E-04	2.67E-04	9E-07	0.009	9%	10%
Bromodichloromethane	ND	NA	0.000037	ND	ND	ND	ND	NA	NA
Bromoform	ND	NA	0.0000011	ND	ND	ND	ND	NA	NA
Carbon tetrachloride	4.59E-04	0.1	0.000006	1.89E-04	4.40E-04	1E-06	0.004	11%	5%
Chlorobenzene	ND	0.05	NA	ND	ND	ND	ND	NA	NA
Chloroform	1.37E-04	0.098	0.000023	5.63E-05	1.31E-04	1E-06	0.001	13%	2%
cis-1,2-Dichloroethene	ND	0.035	NA	ND	ND	ND	ND	NA	NA
Ethylbenzene	1.95E-04	1	0.0000025	8.01E-05	1.87E-04	2E-07	0.0002	2%	0.2%
Isopropylbenzene	ND	0.4	NA	ND	ND	ND	ND	NA	NA
Methylene chloride	ND	1	0.00000047	ND	ND	ND	ND	NA	NA
Methyl tert butyl ether	ND	3	0.00000026	ND	ND	ND	ND	NA	NA
Naphthalene	1.36E-04	0.003	0.000034	5.59E-05	1.30E-04	2E-06	0.04	18%	49%
Tetrachloroethene	ND	0.27	0.0000059	ND	ND	ND	ND	NA	NA
Toluene	1.20E-03	5	NA	NA	1.15E-03	NA	0.0002	NA	0.3%
trans-1,2-Dichloroethene	ND	0.06	NA	ND	ND	ND	ND	NA	NA
trans-1,3-Dichloropropene	ND	0.02	0.000004	ND	ND	ND	ND	NA	NA
Trichloroethene	ND	NA	0.000002	ND	ND	ND	ND	NA	NA
Vinyl chloride	ND	0.1	0.0000044	ND	ND	ND	ND	NA	NA
Xylenes	6.17E-04	0.1	NA	NA	5.92E-04	NA	0.006	NA	7%
Total						1E-05	0.09	100%	100%

$$ADE = \frac{EPC_{air} \times ET \times EF \times ED}{AT}$$

$$HI_{inh} = \frac{ADE}{RfC}$$

$$Risk = ADE \times URF \times CF$$

**Notes:**

(a) EPC calculated as average of detected concentrations and one-half indoor air detection limit for non-detects.

EC = exposure concentration

EPC = exposure point concentration

RfC = reference concentration

URF = unit risk factor

ADE-c = average daily exposure (cancer)

ADE-nc = average daily exposure (noncancer)

HI = noncancer hazard index

ug/mg3 = microgram per cubic milligram

NA = Not available

ND = Not detected

mg/m3 = milligram per cubic meter

**Table A7. Estimated Risks to a Resident from Short Term Exposure to Volatile Constituents in Indoor Air via Inhalation - Sample IA-1 26/05/05 North Combined Risks**

Parameter	Definition	Units	Value
ET	Indoor Air Exposure Time	hours/day	24
EF	Indoor Air Exposure Frequency	days/yr	350
ED	Indoor Air Exposure Duration	years	5
ATc	Indoor Air Averaging Time - Cancer	hours	613200
ATn	Indoor Air Averaging Time - Non-Cancer	hours	43800
CF	Conversion Factor	ug/mg	1000

Compound	EPC (a) Indoor Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	ADE-c mg/m3	ADE-nc mg/m3	Cancer Risk Indoor Air (unitless)	HI Indoor Air (unitless)	% of Total Cancer Risk (unitless)	% of Total Noncancer HI (unitless)
1,1,1-Trichloroethane	ND	5	NA	ND	ND	ND	ND	NA	NA
1,1,2-Trichloroethane	ND	NA	0.000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethane	ND	NA	0.0000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,2,4-Trimethylbenzene	2.85E-04	0.007	NA	NA	2.73E-04	NA	0.04	NA	24%
1,2-Dibromoethane	ND	0.009	0.0006	ND	ND	ND	ND	NA	NA
1,2-Dichloroethane	2.18E-04	2.4	0.000026	1.49E-05	2.09E-04	4E-07	0.00009	20%	0.05%
1,2-Dichloropropane	ND	0.004	0.00001	ND	ND	ND	ND	NA	NA
1,3-Butadiene	1.04E-04	0.002	0.00003	7.12E-06	9.97E-05	2E-07	0.05	11%	30%
1,3-Dichlorobenzene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,4-Dichlorobenzene	ND	0.8	0.000011	ND	ND	ND	ND	NA	NA
Benzene	5.99E-04	0.03	0.0000078	4.10E-05	5.74E-04	3E-07	0.02	17%	12%
Bromodichloromethane	ND	NA	0.000037	ND	ND	ND	ND	NA	NA
Bromoform	ND	NA	0.0000011	ND	ND	ND	ND	NA	NA
Carbon tetrachloride	3.77E-04	0.1	0.000006	2.58E-05	3.62E-04	2E-07	0.004	8%	2%
Chlorobenzene	ND	0.05	NA	ND	ND	ND	ND	NA	NA
Chloroform	2.39E-04	0.098	0.000023	1.64E-05	2.29E-04	4E-07	0.002	20%	1%
cis-1,2-Dichloroethene	ND	0.035	NA	ND	ND	ND	ND	NA	NA
Ethylbenzene	5.17E-04	1	0.0000025	3.54E-05	4.95E-04	9E-08	0.0005	5%	0.3%
Isopropylbenzene	ND	0.4	NA	ND	ND	ND	ND	NA	NA
Methylene chloride	ND	1	0.00000047	ND	ND	ND	ND	NA	NA
Methyl tert butyl ether	ND	3	0.00000026	ND	ND	ND	ND	NA	NA
Naphthalene	1.15E-04	0.003	0.000034	7.88E-06	1.10E-04	3E-07	0.04	14%	22%
Tetrachloroethene	2.17E-04	0.27	0.0000059	1.49E-05	2.08E-04	9E-08	0.0008	5%	0.5%
Toluene	2.49E-03	5	NA	NA	2.38E-03	NA	0.0005	NA	0.3%
trans-1,2-Dichloroethene	ND	0.06	NA	ND	ND	ND	ND	NA	NA
trans-1,3-Dichloropropene	ND	0.02	0.000004	ND	ND	ND	ND	NA	NA
Trichloroethene	ND	NA	0.000002	ND	ND	ND	ND	NA	NA
Vinyl chloride	ND	0.1	0.0000044	ND	ND	ND	ND	NA	NA
Xylenes	1.27E-03	0.1	NA	NA	1.22E-03	NA	0.01	NA	7%
Total						2E-06	0.2	100%	100%

$$ADE = \frac{EPC_{air} \times ET \times EF \times ED}{AT}$$

$$HI_{inh} = \frac{ADE}{RfC}$$

$$Risk = ADE \times URF \times CF$$

**Notes:**

(a) EPC calculated as average of detected concentrations and one-half indoor air detection limit for non-detects.

EC = exposure concentration

EPC = exposure point concentration

RfC = reference concentration

URF = unit risk factor

ADE-c = average daily exposure (cancer)

ADE-nc = average daily exposure (noncancer)

HI = noncancer hazard index

ug/mg3 = microgram per cubic milligram

NA = Not available

ND = Not detected

mg/m3 = milligram per cubic meter

**Table A8. Estimated Risks to a Resident from Long Term Exposure to Volatile Constituents in Indoor Air via Inhalation - Sample IA-1 26/05/05 North Combined Risks**

Parameter	Definition	Units	Value
ET	Indoor Air Exposure Time	hours/day	24
EF	Indoor Air Exposure Frequency	days/yr	350
ED	Indoor Air Exposure Duration	years	30
ATc	Indoor Air Averaging Time - Cancer	hours	613200
ATn	Indoor Air Averaging Time - Non-Cancer	hours	262800
CF	Conversion Factor	ug/mg	1000

Compound	EPC (a) Indoor Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	ADE-c mg/m3	ADE-nc mg/m3	Cancer Risk Indoor Air (unitless)	HI Indoor Air (unitless)	% of Total Cancer Risk (unitless)	% of Total Noncancer HI (unitless)
1,1,1-Trichloroethane	ND	5	NA	ND	ND	ND	ND	NA	NA
1,1,2-Trichloroethane	ND	NA	0.000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethane	ND	NA	0.0000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,2,4-Trimethylbenzene	2.85E-04	0.007	NA	NA	2.73E-04	NA	0.04	NA	24%
1,2-Dibromoethane	ND	0.009	0.0006	ND	ND	ND	ND	NA	NA
1,2-Dichloroethane	2.18E-04	2.4	0.000026	8.96E-05	2.09E-04	2E-06	0.00009	20%	0.05%
1,2-Dichloropropane	ND	0.004	0.00001	ND	ND	ND	ND	NA	NA
1,3-Butadiene	1.04E-04	0.002	0.00003	4.27E-05	9.97E-05	1E-06	0.05	11%	30%
1,3-Dichlorobenzene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,4-Dichlorobenzene	ND	0.8	0.000011	ND	ND	ND	ND	NA	NA
Benzene	5.99E-04	0.03	0.0000078	2.46E-04	5.74E-04	2E-06	0.02	17%	12%
Bromodichloromethane	ND	NA	0.000037	ND	ND	ND	ND	NA	NA
Bromoform	ND	NA	0.0000011	ND	ND	ND	ND	NA	NA
Carbon tetrachloride	3.77E-04	0.1	0.000006	1.55E-04	3.62E-04	9E-07	0.004	8%	2%
Chlorobenzene	ND	0.05	NA	ND	ND	ND	ND	NA	NA
Chloroform	2.39E-04	0.098	0.000023	9.82E-05	2.29E-04	2E-06	0.002	20%	1%
cis-1,2-Dichloroethene	ND	0.035	NA	ND	ND	ND	ND	NA	NA
Ethylbenzene	5.17E-04	1	0.0000025	2.12E-04	4.95E-04	5E-07	0.0005	5%	0.3%
Isopropylbenzene	ND	0.4	NA	ND	ND	ND	ND	NA	NA
Methylene chloride	ND	1	0.00000047	ND	ND	ND	ND	NA	NA
Methyl tert butyl ether	ND	3	0.00000026	ND	ND	ND	ND	NA	NA
Naphthalene	1.15E-04	0.003	0.000034	4.73E-05	1.10E-04	2E-06	0.04	14%	22%
Tetrachloroethene	2.17E-04	0.27	0.0000059	8.92E-05	2.08E-04	5E-07	0.0008	5%	0.5%
Toluene	2.49E-03	5	NA	NA	2.38E-03	NA	0.0005	NA	0.3%
trans-1,2-Dichloroethene	ND	0.06	NA	ND	ND	ND	ND	NA	NA
trans-1,3-Dichloropropene	ND	0.02	0.000004	ND	ND	ND	ND	NA	NA
Trichloroethene	ND	NA	0.000002	ND	ND	ND	ND	NA	NA
Vinyl chloride	ND	0.1	0.0000044	ND	ND	ND	ND	NA	NA
Xylenes	1.27E-03	0.1	NA	NA	1.22E-03	NA	0.01	NA	7%
Total						1E-05	0.2	100%	100%

$$ADE = \frac{EPC_{air} \times ET \times EF \times ED}{AT}$$

$$HI_{inh} = \frac{ADE}{RfC}$$

$$Risk = ADE \times URF \times CF$$

**Notes:**

(a) EPC calculated as average of detected concentrations and one-half indoor air detection limit for non-detects.

EC = exposure concentration

EPC = exposure point concentration

RfC = reference concentration

URF = unit risk factor

ADE-c = average daily exposure (cancer)

ADE-nc = average daily exposure (noncancer)

HI = noncancer hazard index

ug/mg3 = microgram per cubic milligram

NA = Not available

ND = Not detected

mg/m3 = milligram per cubic meter

**Table A9. Estimated Risks to a Resident from Short Term Exposure to Volatile Constituents in Indoor Air via Inhalation - Sample IA-2 26/05/05 North Combined Risks**

Parameter	Definition	Units	Value
ET	Indoor Air Exposure Time	hours/day	24
EF	Indoor Air Exposure Frequency	days/yr	350
ED	Indoor Air Exposure Duration	years	5
ATc	Indoor Air Averaging Time - Cancer	hours	613200
ATn	Indoor Air Averaging Time - Non-Cancer	hours	43800
CF	Conversion Factor	ug/mg	1000

Compound	EPC (a) Indoor Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	ADE-c mg/m3	ADE-nc mg/m3	Cancer Risk Indoor Air (unitless)	HI Indoor Air (unitless)	% of Total Cancer Risk (unitless)	% of Total Noncancer HI (unitless)
1,1,1-Trichloroethane	ND	5	NA	ND	ND	ND	ND	NA	NA
1,1,2-Trichloroethane	ND	NA	0.000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethane	ND	NA	0.0000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,2,4-Trimethylbenzene	3.00E-04	0.007	NA	NA	2.88E-04	NA	0.04	NA	22%
1,2-Dibromoethane	ND	0.009	0.0006	ND	ND	ND	ND	NA	NA
1,2-Dichloroethane	2.15E-04	2.4	0.000026	1.47E-05	2.06E-04	4E-07	0.00009	19%	0.05%
1,2-Dichloropropane	ND	0.004	0.00001	ND	ND	ND	ND	NA	NA
1,3-Butadiene	1.24E-04	0.002	0.00003	8.46E-06	1.18E-04	3E-07	0.06	13%	32%
1,3-Dichlorobenzene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,4-Dichlorobenzene	ND	0.8	0.000011	ND	ND	ND	ND	NA	NA
Benzene	6.55E-04	0.03	0.0000078	4.48E-05	6.28E-04	3E-07	0.02	18%	11%
Bromodichloromethane	ND	NA	0.000037	ND	ND	ND	ND	NA	NA
Bromoform	ND	NA	0.0000011	ND	ND	ND	ND	NA	NA
Carbon tetrachloride	3.99E-04	0.1	0.000006	2.73E-05	3.83E-04	2E-07	0.004	8%	2%
Chlorobenzene	ND	0.05	NA	ND	ND	ND	ND	NA	NA
Chloroform	2.27E-04	0.098	0.000023	1.55E-05	2.18E-04	4E-07	0.002	18%	1%
cis-1,2-Dichloroethene	ND	0.035	NA	ND	ND	ND	ND	NA	NA
Ethylbenzene	5.34E-04	1	0.0000025	3.66E-05	5.12E-04	9E-08	0.001	5%	0.3%
Isopropylbenzene	ND	0.4	NA	ND	ND	ND	ND	NA	NA
Methylene chloride	ND	1	0.00000047	ND	ND	ND	ND	NA	NA
Methyl tert butyl ether	ND	3	0.00000026	ND	ND	ND	ND	NA	NA
Naphthalene	1.34E-04	0.003	0.000034	9.16E-06	1.28E-04	3E-07	0.04	16%	23%
Tetrachloroethene	2.17E-04	0.27	0.0000059	1.49E-05	2.08E-04	9E-08	0.0008	4%	0.4%
Toluene	2.33E-03	5	NA	NA	2.23E-03	NA	0.0004	NA	0.2%
trans-1,2-Dichloroethene	ND	0.06	NA	ND	ND	ND	ND	NA	NA
trans-1,3-Dichloropropene	ND	0.02	0.000004	ND	ND	ND	ND	NA	NA
Trichloroethene	ND	NA	0.000002	ND	ND	ND	ND	NA	NA
Vinyl chloride	ND	0.1	0.0000044	ND	ND	ND	ND	NA	NA
Xylenes	1.38E-03	0.1	NA	NA	1.32E-03	NA	0.01	NA	7%
Total						2E-06	0.2	100%	100%

$$ADE = \frac{EPC_{air} \times ET \times EF \times ED}{AT}$$

$$HI_{inh} = \frac{ADE}{RfC}$$

$$Risk = ADE \times URF \times CF$$

**Notes:**

(a) EPC calculated as average of detected concentrations and one-half indoor air detection limit for non-detects.

EC = exposure concentration

EPC = exposure point concentration

RfC = reference concentration

URF = unit risk factor

ADE-c = average daily exposure (cancer)

ADE-nc = average daily exposure (noncancer)

HI = noncancer hazard index

ug/mg3 = microgram per cubic milligram

NA = Not available

ND = Not detected

mg/m3 = milligram per cubic meter

**Table A10. Estimated Risks to a Resident from Long Term Exposure to Volatile Constituents in Indoor Air via Inhalation - Sample IA-2 26/05/05 North Combined Risks**

Parameter	Definition	Units	Value
ET	Indoor Air Exposure Time	hours/day	24
EF	Indoor Air Exposure Frequency	days/yr	350
ED	Indoor Air Exposure Duration	years	30
ATc	Indoor Air Averaging Time - Cancer	hours	613200
ATn	Indoor Air Averaging Time - Non-Cancer	hours	262800
CF	Conversion Factor	ug/mg	1000

Compound	EPC (a) Indoor Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	ADE-c mg/m3	ADE-nc mg/m3	Cancer Risk Indoor Air (unitless)	HI Indoor Air (unitless)	% of Total Cancer Risk (unitless)	% of Total Noncancer HI (unitless)
1,1,1-Trichloroethane	ND	5	NA	ND	ND	ND	ND	NA	NA
1,1,2-Trichloroethane	ND	NA	0.000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethane	ND	NA	0.0000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,2,4-Trimethylbenzene	3.00E-04	0.007	NA	NA	2.88E-04	NA	0.04	NA	22%
1,2-Dibromoethane	ND	0.009	0.0006	ND	ND	ND	ND	NA	NA
1,2-Dichloroethane	2.15E-04	2.4	0.000026	8.82E-05	2.06E-04	2E-06	0.00009	19%	0.05%
1,2-Dichloropropane	ND	0.004	0.00001	ND	ND	ND	ND	NA	NA
1,3-Butadiene	1.24E-04	0.002	0.00003	5.08E-05	1.18E-04	2E-06	0.06	13%	32%
1,3-Dichlorobenzene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,4-Dichlorobenzene	ND	0.8	0.000011	ND	ND	ND	ND	NA	NA
Benzene	6.55E-04	0.03	0.0000078	2.69E-04	6.28E-04	2E-06	0.02	18%	11%
Bromodichloromethane	ND	NA	0.000037	ND	ND	ND	ND	NA	NA
Bromoform	ND	NA	0.0000011	ND	ND	ND	ND	NA	NA
Carbon tetrachloride	3.99E-04	0.1	0.000006	1.64E-04	3.83E-04	1E-06	0.004	8%	2%
Chlorobenzene	ND	0.05	NA	ND	ND	ND	ND	NA	NA
Chloroform	2.27E-04	0.098	0.000023	9.33E-05	2.18E-04	2E-06	0.002	18%	1%
cis-1,2-Dichloroethene	ND	0.035	NA	ND	ND	ND	ND	NA	NA
Ethylbenzene	5.34E-04	1	0.0000025	2.19E-04	5.12E-04	5E-07	0.0005	5%	0.3%
Isopropylbenzene	ND	0.4	NA	ND	ND	ND	ND	NA	NA
Methylene chloride	ND	1	0.00000047	ND	ND	ND	ND	NA	NA
Methyl tert butyl ether	ND	3	0.00000026	ND	ND	ND	ND	NA	NA
Naphthalene	1.34E-04	0.003	0.000034	5.50E-05	1.28E-04	2E-06	0.04	16%	23%
Tetrachloroethene	2.17E-04	0.27	0.0000059	8.92E-05	2.08E-04	5E-07	0.0008	4%	0.4%
Toluene	2.33E-03	5	NA	NA	2.23E-03	NA	0.0004	NA	0.2%
trans-1,2-Dichloroethene	ND	0.06	NA	ND	ND	ND	ND	NA	NA
trans-1,3-Dichloropropene	ND	0.02	0.000004	ND	ND	ND	ND	NA	NA
Trichloroethene	ND	NA	0.000002	ND	ND	ND	ND	NA	NA
Vinyl chloride	ND	0.1	0.0000044	ND	ND	ND	ND	NA	NA
Xylenes	1.38E-03	0.1	NA	NA	1.32E-03	NA	0.01	NA	7%
Total						1E-05	0.2	100%	100%

$$ADE = \frac{EPC_{air} \times ET \times EF \times ED}{AT}$$

$$HI_{inh} = \frac{ADE}{RfC}$$

$$Risk = ADE \times URF \times CF$$

**Notes:**

(a) EPC calculated as average of detected concentrations and one-half indoor air detection limit for non-detects.

EC = exposure concentration

EPC = exposure point concentration

RfC = reference concentration

URF = unit risk factor

ADE-c = average daily exposure (cancer)

ADE-nc = average daily exposure (noncancer)

HI = noncancer hazard index

ug/mg3 = microgram per cubic milligram

NA = Not available

ND = Not detected

mg/m3 = milligram per cubic meter

**Table A11. Estimated Risks to a Resident from Short Term Exposure to Volatile Constituents in Indoor Air via Inhalation - Sample IA-3 26/05/05 North Combined Risks**

Parameter	Definition	Units	Value
ET	Indoor Air Exposure Time	hours/day	24
EF	Indoor Air Exposure Frequency	days/yr	350
ED	Indoor Air Exposure Duration	years	5
ATc	Indoor Air Averaging Time - Cancer	hours	613200
ATn	Indoor Air Averaging Time - Non-Cancer	hours	43800
CF	Conversion Factor	ug/mg	1000

Compound	EPC (a) Indoor Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	ADE-c mg/m3	ADE-nc mg/m3	Cancer Risk Indoor Air (unitless)	HI Indoor Air (unitless)	% of Total Cancer Risk (unitless)	% of Total Noncancer HI (unitless)
1,1,1-Trichloroethane	ND	5	NA	ND	ND	ND	ND	NA	NA
1,1,2-Trichloroethane	ND	NA	0.000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethane	ND	NA	0.0000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,2,4-Trimethylbenzene	2.90E-04	0.007	NA	NA	2.78E-04	NA	0.04	NA	22%
1,2-Dibromoethane	ND	0.009	0.0006	ND	ND	ND	ND	NA	NA
1,2-Dichloroethane	4.19E-04	2.4	0.000026	2.87E-05	4.01E-04	7E-07	0.0002	33%	0.09%
1,2-Dichloropropane	ND	0.004	0.00001	ND	ND	ND	ND	NA	NA
1,3-Butadiene	1.25E-04	0.002	0.00003	8.56E-06	1.20E-04	3E-07	0.06	11%	33%
1,3-Dichlorobenzene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,4-Dichlorobenzene	ND	0.8	0.000011	ND	ND	ND	ND	NA	NA
Benzene	6.34E-04	0.03	0.0000078	4.34E-05	6.08E-04	3E-07	0.02	15%	11%
Bromodichloromethane	ND	NA	0.000037	ND	ND	ND	ND	NA	NA
Bromoform	ND	NA	0.0000011	ND	ND	ND	ND	NA	NA
Carbon tetrachloride	4.03E-04	0.1	0.000006	2.76E-05	3.86E-04	2E-07	0.004	7%	2%
Chlorobenzene	ND	0.05	NA	ND	ND	ND	ND	NA	NA
Chloroform	1.96E-04	0.098	0.000023	1.34E-05	1.87E-04	3E-07	0.002	14%	1%
cis-1,2-Dichloroethene	ND	0.035	NA	ND	ND	ND	ND	NA	NA
Ethylbenzene	4.10E-04	1	0.0000025	2.81E-05	3.93E-04	7E-08	0.0004	3%	0.2%
Isopropylbenzene	ND	0.4	NA	ND	ND	ND	ND	NA	NA
Methylene chloride	ND	1	0.00000047	ND	ND	ND	ND	NA	NA
Methyl tert butyl ether	ND	3	0.00000026	ND	ND	ND	ND	NA	NA
Naphthalene	1.34E-04	0.003	0.000034	9.14E-06	1.28E-04	3E-07	0.04	14%	23%
Tetrachloroethene	1.80E-04	0.27	0.0000059	1.23E-05	1.72E-04	7E-08	0.0006	3%	0.3%
Toluene	2.08E-03	5	NA	NA	1.99E-03	NA	0.0004	NA	0.2%
trans-1,2-Dichloroethene	ND	0.06	NA	ND	ND	ND	ND	NA	NA
trans-1,3-Dichloropropene	ND	0.02	0.000004	ND	ND	ND	ND	NA	NA
Trichloroethene	ND	NA	0.000002	ND	ND	ND	ND	NA	NA
Vinyl chloride	ND	0.1	0.0000044	ND	ND	ND	ND	NA	NA
Xylenes	1.28E-03	0.1	NA	NA	1.23E-03	NA	0.01	NA	7%
Total						2E-06	0.2	100%	100%

$$ADE = \frac{EPC_{air} \times ET \times EF \times ED}{AT}$$

$$HI_{inh} = \frac{ADE}{RfC}$$

$$Risk = ADE \times URF \times CF$$

**Notes:**

(a) EPC calculated as average of detected concentrations and one-half indoor air detection limit for non-detects.

EC = exposure concentration

EPC = exposure point concentration

RfC = reference concentration

URF = unit risk factor

ADE-c = average daily exposure (cancer)

ADE-nc = average daily exposure (noncancer)

HI = noncancer hazard index

ug/mg3 = microgram per cubic milligram

NA = Not available

ND = Not detected

mg/m3 = milligram per cubic meter

**Table A12. Estimated Risks to a Resident from Long Term Exposure to Volatile Constituents in Indoor Air via Inhalation - Sample IA-3 26/05/05 North Combined Risks**

Parameter	Definition	Units	Value
ET	Indoor Air Exposure Time	hours/day	24
EF	Indoor Air Exposure Frequency	days/yr	350
ED	Indoor Air Exposure Duration	years	30
ATc	Indoor Air Averaging Time - Cancer	hours	613200
ATn	Indoor Air Averaging Time - Non-Cancer	hours	262800
CF	Conversion Factor	ug/mg	1000

Compound	EPC (a) Indoor Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	ADE-c mg/m3	ADE-nc mg/m3	Cancer Risk Indoor Air (unitless)	HI Indoor Air (unitless)	% of Total Cancer Risk (unitless)	% of Total Noncancer HI (unitless)
1,1,1-Trichloroethane	ND	5	NA	ND	ND	ND	ND	NA	NA
1,1,2-Trichloroethane	ND	NA	0.000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethane	ND	NA	0.0000016	ND	ND	ND	ND	NA	NA
1,1-Dichloroethene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,2,4-Trimethylbenzene	2.90E-04	0.007	NA	NA	2.78E-04	NA	0.04	NA	22%
1,2-Dibromoethane	ND	0.009	0.0006	ND	ND	ND	ND	NA	NA
1,2-Dichloroethane	4.19E-04	2.4	0.000026	1.72E-04	4.01E-04	4E-06	0.0002	33%	0.09%
1,2-Dichloropropane	ND	0.004	0.00001	ND	ND	ND	ND	NA	NA
1,3-Butadiene	1.25E-04	0.002	0.00003	5.14E-05	1.20E-04	2E-06	0.06	11%	33%
1,3-Dichlorobenzene	ND	0.2	NA	ND	ND	ND	ND	NA	NA
1,4-Dichlorobenzene	ND	0.8	0.000011	ND	ND	ND	ND	NA	NA
Benzene	6.34E-04	0.03	0.0000078	2.61E-04	6.08E-04	2E-06	0.02	15%	11%
Bromodichloromethane	ND	NA	0.000037	ND	ND	ND	ND	NA	NA
Bromoform	ND	NA	0.0000011	ND	ND	ND	ND	NA	NA
Carbon tetrachloride	4.03E-04	0.1	0.000006	1.65E-04	3.86E-04	1E-06	0.004	7%	2%
Chlorobenzene	ND	0.05	NA	ND	ND	ND	ND	NA	NA
Chloroform	1.96E-04	0.098	0.000023	8.03E-05	1.87E-04	2E-06	0.002	14%	1%
cis-1,2-Dichloroethene	ND	0.035	NA	ND	ND	ND	ND	NA	NA
Ethylbenzene	4.10E-04	1	0.0000025	1.68E-04	3.93E-04	4E-07	0.0004	3%	0.2%
Isopropylbenzene	ND	0.4	NA	ND	ND	ND	ND	NA	NA
Methylene chloride	ND	1	0.00000047	ND	ND	ND	ND	NA	NA
Methyl tert butyl ether	ND	3	0.00000026	ND	ND	ND	ND	NA	NA
Naphthalene	1.34E-04	0.003	0.000034	5.49E-05	1.28E-04	2E-06	0.04	14%	23%
Tetrachloroethene	1.80E-04	0.27	0.0000059	7.38E-05	1.72E-04	4E-07	0.0006	3%	0.3%
Toluene	2.08E-03	5	NA	NA	1.99E-03	NA	0.0004	NA	0.2%
trans-1,2-Dichloroethene	ND	0.06	NA	ND	ND	ND	ND	NA	NA
trans-1,3-Dichloropropene	ND	0.02	0.000004	ND	ND	ND	ND	NA	NA
Trichloroethene	ND	NA	0.000002	ND	ND	ND	ND	NA	NA
Vinyl chloride	ND	0.1	0.0000044	ND	ND	ND	ND	NA	NA
Xylenes	1.28E-03	0.1	NA	NA	1.23E-03	NA	0.01	NA	7%
Total						1E-05	0.2	100%	100%

$$ADE = \frac{EPC_{air} \times ET \times EF \times ED}{AT}$$

$$HI_{inh} = \frac{ADE}{RfC}$$

$$Risk = ADE \times URF \times CF$$

**Notes:**

(a) EPC calculated as average of detected concentrations and one-half indoor air detection limit for non-detects.

EC = exposure concentration

EPC = exposure point concentration

RfC = reference concentration

URF = unit risk factor

ADE-c = average daily exposure (cancer)

ADE-nc = average daily exposure (noncancer)

HI = noncancer hazard index

ug/mg3 = microgram per cubic milligram

NA = Not available

ND = Not detected

mg/m3 = milligram per cubic meter